Essays in International Trade

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Chapter 1

Introduction

International trade is one of the driving forces behind the process of globalization. It has grown at unprecedented speed during the past decades. In volume terms, world trade expanded more than twenty-seven fold between 1950 and 2005, which corresponds to an average annual growth rate of 6.2% (World Trade Organization, 2007). To a large extent, this development can be attributed to technological advances in the transport sector, such as the spread of container shipping, to lower information and communication costs, and to the reduction of tariffs in successive rounds of multilateral trade negotiations (Jacks et al., 2008).

Trade theory generally predicts and empirical studies broadly confirm that open borders allow countries to realize gains from specialization in production (e.g. Bernhofen and Brown, 2005). Lower tariffs and transport costs encourage productive firms to intensify their export activities. Competition increases, inefficient firms are driven out of the market, and aggregate productivity rises (e.g. Melitz, 2003; Melitz and Ottaviano, 2008; Pavcnik, 2002; Bernard et al., 2006). Consumers benefit from a larger variety of goods (e.g. Broda and Weinstein, 2006) and lower prices (e.g. Harald, 2007).

This thesis is a collection of three essays which address very different questions relating to this literature. Chapter two analyzes the welfare effects of trade liberalization for consumers which do not behave fully rationally, as standard trade theory suggests, but suffer from self-control problems. For them, lower prices and a larger choice of goods may be harmful rather than beneficial. Chapter three shifts the focus to heterogeneous firms which differ in their preferences about trade policies, and analyzes the level of protection that emerges from a political process in which not all firms are equally involved. Chapter four adds empirical evidence on the question of how firms actually ship their goods abroad and how the choice of export mode depends on specific firm characteristics.

Against the paradigm of rationality, consumers often make economic decisions which violate their own preferences. This perception is substantiated by recent experimental and econometric evidence. If consumers suffer from self-control problems, for instance,

they overvalue the immediate benefits of goods such as cigarettes, alcohol, or fast food, and neglect the future costs of an unhealthy lifestyle. As a consequence, they consume too much of these goods, as judged from their own perspective. If trade liberalization leads to more variety and lower prices, the problem of overconsumption may get worse, and the traditional gains from trade may vanish.

Chapter two analyzes the conditions under which consumers with self-control problems may lose from trade, and the role that production technology and market structure play for the welfare impact of trade on such boundedly rational consumers. To this end, self-control problems are first integrated into a dynamic Ricardian model of inter-industry trade with two countries and two goods, one of which is associated with self-control problems. Self-control problems are modeled as time-inconsistent preferences for immediate gratification which are captured by a quasi-hyperbolic discount function. Consumers may differ in the severity of their self-control problem. In this setting, the welfare effects of trade depend on the direction of trade, the degree of self-control, and the price-sensitivity of consumers. Consumers in the country that imports the good associated with self-control problems may lose, provided that their self-control problem and their reaction to a price reduction is sufficiently strong. In this case, the loss due to increased overconsumption overcompensates the traditional gains from specialization. Imposing a tariff on the imported good that is associated with self-control problems and redistributing the proceeds in a lump sum fashion alleviates the problem of overconsumption and makes trade a Pareto-improvement. In the exporting country, no such policy is required, as the increase in the price of the exported good mitigates rather than exacerbates the problem of overconsumption for consumers with low self-control.

These results are quite intuitive and mainly driven by price movements. Changing the assumptions on production technology and market structure does however lead to surprising conclusions. In a trade model with increasing returns to scale and monopolistic competition, consumers with self-control problems may lose in both countries, as variety increases and prices decrease on both sides of the border. In fact, even fully rational consumers may lose from trade if there is heterogeneity in the degree of self-control not only within countries, but also across countries. In particular, if a country starts trading with another country in which the average degree of self-control is larger, aggregate demand and hence the available product variety may be reduced through trade, which makes fully self-controlled consumers worse off.

This chapter does not only bridge a gap between international trade theory and behavioral economics, an economic discipline which has caught a lot of attention in the last decade. It also has some implications for real world situations. During the 1980's, for instance, some Asian countries were forced to drastically cut their import tariffs on cigarettes, and per capita consumption of cigarettes significantly increased. If this were the consequence of fully rational consumer behavior, then trade would be nothing to worry about. However, if consumers suffered from self-control problems as the evidence

suggests, the reduction of import tariffs created a need for compensating government action.

Chapter three shifts the perspective from heterogeneous consumers to heterogeneous firms and the endogenous formation of trade policies.

That firms play an important role in shaping trade policies is uncontroversial. Likewise, it is uncontested that some firms exert more pressure than others. Empirical evidence from political science suggests that it is predominantly large firms which lobby for trade policies, while small firms usually lack the resources necessary to raise their voices. If large and small firms also differ in their interests regarding trade policies, the fact that only the large firms lobby has important implications for the level of protection that emerges from the political process.

Chapter three develops a model of intra-industry trade and shows that there is indeed a conflict of interest between large and small firms when it comes to non-tariff barriers to trade such as technical standards, certification requirements, or testing procedures which raise the fixed costs of gaining market access. Due to the national treatment principle of the World Trade Organization, such regulations apply to both foreign exporters and domestic firms. Small and inefficient domestic firms are not able to cover the higher fixed costs associated with additional regulations and exit the market. This allows large and productive firms to reap additional market shares and profits. Thus, although non-tariff barriers to trade are inefficient from a social welfare perspective, the model suggests that if only the largest firms lobby the domestic government, non-tariff barriers to trade will nevertheless be implemented, which is consistent with recent evidence on the prevalence of technical barriers to trade. Comparative static exercises show that the equilibrium level of technical barriers to trade is the higher the stronger the profit-shifting effect between domestic firms, and the weaker the government's concern about social welfare.

The analysis is extended to other non-tariff barriers to trade such as customs and administrative procedures which affect only foreign exporters. Such regulations do not create a conflict of interest among domestic firms, which are shielded from foreign competition and make higher profits at the expense of the domestic consumers, who have less varieties at their disposal. Although they are welfare reducing, the domestic government may implement such measures in the political equilibrium, provided that the domestic firms' gains from such regulations loom large and the government does not care much about social welfare.

The model presented in the third chapter of this thesis adds to the existing literature on the political economy of trade policy by emphasizing the role of trade barriers which represent fixed costs. Most of the contributions that followed the seminal "Protection for Sale" model of Grossman and Helpman (1994) focus on variable trade costs such as import tariffs and export subsidies, which have recently lost importance relative to non-tariff barriers to trade. Also, Grossman and Helpman (1994) and most other papers

in this line of literature perform a purely sectoral analysis without paying attention to the role of individual firms.

Chapter four adds some empirical evidence on the export behavior of firms. Opposed to what international trade theory typically assumes, manufacturers do not always ship their goods directly to their foreign customers, but call in trade intermediaries to perform this task for them. These are economic agents such as wholesalers, retailers and trading companies in the importing and exporting country which help manufacturers and customers to meet and transact (Spulber, 1998). Which manufacturers make use of this option? Theory suggests that it is mostly the small firms which are not profitable enough to cover the high fixed costs of building an own distribution network abroad. However, intermediated trade is generally associated with higher variable trade costs and lower export revenues due to additional markups on side of the intermediary or difficulties related to the enforcement of contracts between the intermediary and the manufacturer. Therefore, large and efficient firms with high export volumes prefer to ship their goods directly to their final consumers. The third chapter brings this hypothesis to a test. Using survey data from the World Bank Enterprise Survey conducted in Turkey in 2008, it shows that there is indeed a negative correlation between firm size and the relative importance of intermediated exports. This result is highly robust to the inclusion of a variety of controls, different estimation methods, and different measures of firm size. Further, being part of a larger company is generally associated with a higher prevalence of indirect exports as opposed to direct exports. Offering new and sophisticated products, on the contrary, leads to relatively less intermediated trade, which is consistent with the idea that innovative firms prefer a higher level of control.

Although these essays represent three independent pieces of research, they are linked by a common theme. In all of them, agent heterogeneity plays an important role for the outcome of international trade relations. The second chapter focuses on consumer heterogeneity and shows that being more or less rational has important consequences for the welfare effects of globalization. Maybe surprisingly, being more rational does not always imply being better off under free trade. The third chapter deals with heterogeneity on side of the firms which produce the traded goods. Empirical studies have shown that firms differ in their size and productivity and hence in their ability to cover the fixed costs associated with accessing the domestic or foreign market. This implies that they also differ in their preferences regarding specific trade policies. If not all firms equally engage in the political process that shapes these trade policies, firm heterogeneity has important implications for the prevailing level of protection. Abstracting from the political dimension of international trade, differences in size and productivity also determine how firms actually ship their goods. Analyzing data from the World Bank Enterprise Survey, the fourth chapter shows that large and productive firms export their goods directly, while small and inefficient firms rather rely on trade intermediaries. In a nutshell, this thesis demonstrates that both consumer and firm heterogeneity matter for

a variety of outcomes in international trade relations. It affects the welfare consequences of globalization, the implementation of protectionist policies, and the choice of different export modes.

Chapter 2

Trade liberalization and self-control problems

2.1 Introduction

A central result in international trade theory and the most powerful argument of the proponents of globalization is that trade liberalization creates welfare gains. In classic trade theory, gains from trade arise from specialization in production and the exploitation of differences in preferences and endowments across countries. Real incomes rise and the average consumer in each country is better off, independent of the direction of trade. New trade theories focus on imperfect competition and increasing returns to scale as sources of gains from trade. When trade is liberalized, firms serve a larger market and average costs decline. Consumers benefit from lower prices and a larger variety of products.

However, in each case the gains from trade result hinges on several assumptions. One of them, which is common to all trade models, is that individuals behave fully rationally in the sense that they would never do anything that violates their own preferences. Yet, recent research in behavioral economics suggests that this is often an inappropriate abstraction. For instance, there is by now substantial experimental and econometric evidence that people suffer from self-control problems when making economic decisions which involve benefits and costs occurring at different points in time.[1] Striving for immediate gratification, they are tempted to consume more than optimal of goods which generate instantaneous benefits but entail future costs. Such goods are also called sin goods. Examples include cigarettes, alcohol, or fast food. Individuals plan to smoke, drink, or eat less in order to enjoy a healthier and happier life, but when the moment of

[1] Frederick et al. (2002) provide a comprehensive overview of the respective studies. Gruber and Köszegi (2004) also review different kinds of evidence on self-control problems, but with a focus on smoking behavior.

the decision has arrived, they revise their plans and consume more cigarettes, alcohol, or unhealthy food than they initially intended to. If trade in such goods is liberalized and leads to an expanded choice set and lower prices, the problem of overconsumption may in fact get worse for some consumers, and gains from trade are no longer guaranteed. When consumers are heterogeneous in their degree of self-control, trade will also have distributional consequences, even if preferences are otherwise identical, and the advantageousness of trade depends on whether feasible redistribution mechanisms exist.

The aim of the present paper is to analyze the welfare effects of trade when consumers lack self-control. Which factors determine who gains and who loses from trade, and how much? Is the distribution of winners and losers within and across countries sensitive to changes in the assumptions on production technology and market structure of the sin good? And finally, can we find instruments that correct for the inefficiencies caused by self-control problems and make trade a Pareto-improvement over autarky, thus saving the gains from trade argument?

To address these questions, self-control problems are first incorporated into a dynamic Ricardian model of inter-industry trade with two countries and two goods. As in O'Donoghue and Rabin (2006), who analyze optimal taxes, self-control problems are modeled as time-inconsistent preferences for immediate gratification which apply to only one of the two goods. Individuals within a country may differ in their degree of self-control. In this setting, the welfare consequences depend on the direction of trade and on the price-sensitivity of consumers. Provided that they react strongly enough to price changes, individuals in the country importing the sin good lose if their self-control problem is sufficiently large, and if the traditional gains due to specialization and exchange are only small. This is because the declining price induces individuals with a lack of willpower to consume even more of the sin good. The loss due to inefficient overconsumption rises and overcompensates the traditional gains from trade. However, if individuals with low self-control are hardly responsive to price changes, trade does not aggravate their problem of overconsumption, and all consumers in the importing country are better off compared to autarky. In case some individuals lose, the welfare gains from trade can be redistributed by imposing a tariff on the imported good such that the price under trade equals the price in autarky and distributing the proceeds in a lump sum fashion. This way, the gains due to specialization can be realized without worsening the problem of overconsumption. In the exporting country, where the relative price of the sin good increases after borders open up, all individuals unambiguously gain from trade. Here, the rising price serves a self-control function, mitigating the problem of overconsumption. The more price-sensitive consumers with low self-control are, the stronger is this beneficial effect, and thus the higher are their gains from trade compared to the gains of the fully self-controlled individuals.

While the results in the Ricardian setting are essentially driven by price movements and are rather intuitive, the integration of self-control problems into a trade model with

increasing returns to scale in production and monopolistic competition leads to surprising conclusions. In this setting, it is no longer the case that individuals with self-control problems gain from trade in at least one country. In fact, trade can lead to a decreasing price and a larger variety of the sin good in both countries, and thus exacerbates the problem of overconsumption for individuals with a lack of willpower on both sides of the border. In addition, heterogeneity in the degree of self-control across countries opens up the possibility that in one country even the fully self-controlled individuals lose from trade. This will be the case if the average degree of self-control is larger in the open economy than in the closed economy. All else equal, a larger average degree of self-control reduces aggregate demand, which reduces the available product variety and thus counteracts the conventional, beneficial effect of trade liberalization for the fully self-controlled. Hence, production technology and market structure play a decisive role in determining who gains and who loses from trade and need to be carefully taken into account when deriving policy recommendations.

By introducing time-inconsistent preferences into models of trade, the present piece of research bridges a gap between international trade theory and new insights from behavioral economics. Even though more realistic psychological foundations of economic behavior have by now found acceptance and applications in macroeconomics, labor economics, and, most notably, finance,[2] they have hardly found their way into international trade theory.[3] The theoretical work most closely related to the present paper deals with the issue of optimal taxation in case individuals have time-inconsistent preferences. O'Donoghue and Rabin (2006) consider a model with two goods, one of which is associated with self-control problems, and analyze whether a small tax on the sin good improves social welfare. In principle, trade liberalization has the same effect like a tax on the price of the sin good in the importing country, and thus has similar implications for individual and social welfare. Yet, the analysis in the present paper differs in some aspects from O'Donoghue and Rabin (2006). First, I will resort to their formulation of preferences, since it makes the model analytically tractable, but I will abstract from population heterogeneity in tastes to further simplify the analysis and concentrate on population heterogeneity in the degree of self-control. Second, their welfare analysis rests on marginal arguments. Such arguments cannot be used to compare autarky with free trade, since these are effectively two different states of the world. Yet another and maybe the most important difference is that the present paper adopts a general equilibrium perspective and explicitly models the production sector and the labor market of the economy, while O'Donoghue and Rabin (2006) assume that marginal costs and hence wages are fixed and that individuals are given an exogenously fixed income.

[2]See Camerer et al. (2004) and Frederick et al. (2002) for a collection of the most important recent contributions.

[3]Two noteworthy exceptions are Freund and Özden (2008) and Tovar (2009), who analyze the implications of loss aversion for trade policy, both theoretically and empirically.

However, analyzing the welfare effects of trade liberalization in the presence of self-control problems is not only of theoretical interest. In the mid 1980's, the U.S. forced four Asian countries to drastically cut their import tariffs on cigarettes by threatening them with retaliatory sanctions. As a consequence, per capita cigarette consumption in these four countries increased significantly (Chaloupka and Laixuthai, 1996). The positive relationship between trade liberalization in general and smoking has been identified for other low- and middle income countries as well (Bettcher et al., 2001; Taylor et al., 2000). The negative health effects of smoking are well documented and have induced the public to blame free trade in cigarettes for reducing the subjective well-being of consumers. Accepting that individuals have time-inconsistent preferences with respect to smoking would support such a claim and provide an economic rationale for government intervention that goes beyond negative externalities or incorrect information. A similar case has been made for unhealthy food. Amongst other factors, the Food and Agriculture Organisation (2008) holds imports of foods from industrialized countries, which are rich in fat and sugar, responsible for changing nutrition patterns and growing obesity in developing countries. As Stutzer (2007) shows empirically, obesity reduces the subjective well-being of individuals who lack self-control. For them, the availability of Western style food does more harm than good.

In the following section, I will illustrate in more detail the case of trade in cigarettes as one example where self-control problems might influence the benefits of free trade. In section 2.3, I will present a simple way to model self-control problems as present-biased preferences. These preferences will then be incorporated into a Ricardian model to analyze the welfare consequences of trade under constant returns to scale and perfect competition in section 2.4. Section 2.5 deals with self-control problems and the welfare consequences of trade in a model with increasing returns to scale and monopolistic competition. Section 2.6 summarizes the results and concludes.

2.2 Self-control problems and the liberalization of trade in cigarettes

In the past thirty years, tariff and non-tariff barriers to trade have been reduced in many countries and for a variety of goods and services, including cigarettes. Tobacco companies such as Philip Morris or British American Tobacco, facing a declining demand in the United States and Western Europe, actively promoted the liberalization of trade in tobacco, and seized the opportunity to target the newly opened markets in Asia, Eastern Europe, the former Soviet Union, and Africa.[4] Consequently, world exports of

[4]Details on the companies' business strategies were revealed in 1998, when once secret tobacco industry documents were made publicly available as a result of legal action. See World Health Organization (2004) and Bettcher et al. (2001) for an overview.

cigarettes increased from 59 billions of pieces in 1960 to 322 billions of pieces in 1980. In 2004, world exports of cigarettes amounted to 749 billions of pieces (Foreign Agricultural Service, 2007).

After having opened their borders to foreign cigarette imports, many countries experienced a sharp increase in per capita consumption of cigarettes. In fact, several empirical studies have confirmed a causal relationship running from trade liberalization to cigarette consumption. For instance, Chaloupka and Laixuthai (1996) analyze annual time series data from 1970 to 1991 for ten Asian countries, four of which were forced to open their markets to U.S. cigarette imports in the mid-1980's under the threat of retaliatory sanctions, namely Japan, South Korea, Taiwan, and Thailand. Their results suggest that per capita consumption in the liberalized countries was on average ten percent higher than it would have been if imports had remained restricted. Hsieh et al. (1999) estimate the demand for domestic and imported cigarettes in Taiwan using 1966-1995 annual time series data. They conclude that opening the borders to U.S. cigarette imports has had two effects. First, consumers have switched from domestic to imported brands and second, overall consumption of cigarettes has increased. These results are in line with Hsu et al. (2005), who compare actual with projected trends for smoking rates in Taiwan for the period after market opening in 1986. Based on data from consumer surveys of the Monopoly Bureau and the National Health Interview Survey they show that in 2001, the actual smoking rates were significantly higher than the projected ones, both for males and females. In addition, the data reveal that per capita consumption of cigarettes in Taiwan increased by 30% from 1986 to 2001. Taylor et al. (2000) use a larger data set including 42 countries from 1970 to 1995. Estimating fixed-effects models separately for low-income, middle-income, and high-income countries with per capita cigarette consumption as the dependent variable, they find that trade openness has had a significantly positive effect on smoking in lower- and middle-income countries. Bettcher et al. (2001) proceed in a similar fashion, but with a larger data set covering 80 countries from 1970 to 1997. Their results are consistent with Taylor et al. (2000), indicating that trade openness has contributed to an increase in per capita cigarette consumption in low- and middle-income countries.

There is also more indirect evidence of the positive relationship between trade liberalization and cigarette consumption. In many countries, including Japan, Taiwan, South Korea, and Thailand, the tobacco industry was controlled by a government run monopoly before trade in tobacco was liberalized. As pointed out by Chaloupka and Laixuthai (1996), opening borders has led to increased competition and lower prices. The inverse relationship between prices and tobacco consumption is in turn well documented, with most estimates of the overall price elasticity ranging from -0,25 to -0,5 for high-income countries. Middle- and low-income countries are generally more price sensitive, with most estimates ranging from -0,5 to -1,0. Lower prices both increase smoking prevalence and boost conditional cigarette demand. For the United States, estimates indicate that

at least half of the overall price elasticity can be attributed to smoking prevalence (see Chaloupka and Warner (2000) and Chaloupka et al. (2000) for a survey of the respective studies). For lower- and middle-income countries, studies separating the effect of prices on prevalence and smoking intensity do not exist, which is partly due to the lack of reliable individual-level data. One exception is a study by Mao and Xiang (1997), who estimate a prevalence elasticity of -0.89 and a conditional demand elasticity of -0.18 in the Chinese province Sichuan.

Unlike other consumer goods, however, cigarettes entail enormous health costs. Numerous epidemiologic studies have shown that smoking is causal for a variety of cancers as well as for several cardiovascular and respiratory diseases.[5] As pointed out by Peto and Lopez (2001), half of lifetime smokers die prematurely. Viscusi and Hersch (2008) estimate that the discounted expected mortality costs of smoking, measured in terms of foregone income due to premature death, amount to 222 $ per pack for a male consumer and 94 $ for a female consumer, assuming a 3% discount rate.

To sum up, there is strong evidence that trade liberalization has led to increased cigarette consumption in the importing countries, and it is an established fact that such an increase has devastating health consequences, although these occur with a delay of several years or even decades.[6] Correspondingly, Mathers and Loncar (2006) predict that the total number of premature, tobacco-related deaths will rise from 5.4 million in 2005 to 8.3 million in 2030. Regional aggregates are not available, but Mathers and Loncar (2006) suggest that it will decline in high-income countries, while it will double in low- and middle income countries. Ezzati and Lopez (2004) estimate that the fraction of adult deaths that can be attributed to smoking was 12% in 2000, with large variations across regions, age, and gender. Males in the industrialized countries had the highest smoking mortality rates, which is not surprising given the long latency and the only recent cutbacks in smoking. However, the developing countries are catching up. Wen et al. (2005) provide estimates for Taiwan, indicating that smoking attributable male mortality will increase from 16% in 2001 to 20% in 2020 if current smoking patterns persist.

From a traditional economic viewpoint, the negative consequences of smoking alone do not justify any intervention. Rational consumers would foresee the future health costs and would take them fully into account when deciding whether and how much to smoke. They weigh the immediate benefits of a cigarette against the future costs and make a decision that maximizes their lifetime utility. Thus, apart from additional effects such as negative externalities or incorrect information about the risks and the addictive potential

[5] The U.S. Department of Health and Human Services (2004) and the World Health Organization (2005) provide a comprehensive overview of the scientific evidence on the health consequences of smoking.

[6] On the delay between the onset of smoking and the occurrence of smoking-related diseases, see Gajalakshmi et al. (2000) and the literature cited therein.

involved, there is no scope for government action.[7] Free trade is the best policy. Yet, there is substantial evidence that this is not quite true. Individuals lack self-control with regard to smoking, and thus make sub-optimal consumption decisions.[8] The traditional gains from trade argument does no longer hold.

2.3 Modeling self-control problems

Self-control problems arise when individuals have time-inconsistent, present-biased preferences. They overvalue the immediate benefits of a good while neglecting the future costs of its consumption and consequently consume more than they would have judged to be optimal from a prior perspective.[9] Present-biased intertemporal preferences are characterized by discount factors which increase over time. In a discrete time setting, this key qualitative feature can be captured by assuming a quasi-hyperbolic discount function. Mainly because of its analytical tractability, such a function has been widely used to model self-control problems since Laibson (1997). Originally, it has been introduced by Phelps and Pollak (1968) to study intergenerational altruism. With a quasi-hyperbolic discount function, the discounted utility of an individual at time t is

$$U_t(u_t, ..., u_T) \equiv u_t + \beta \sum_{\tau=t+1}^{T} \delta^{\tau-t} u_\tau \tag{2.1}$$

where u_t is the instantaneous utility in period t, $\beta \leq 1$, and $\delta \leq 1$. This formulation implies a discount factor of $\beta\delta$ between the current and the next period and a discount factor of δ between two consecutive periods in the future. For $\beta < 1$, the discount factor increases over time, and the individual revises her initial plans for future consumption once the future has arrived. The smaller is β, the larger is the individual's tendency to overvalue immediate benefits and the stronger is the self-control problem. For $\beta = 1$, the discount factor is constant, and we are back to a setting with time-consistent preferences.

Similar to O'Donoghue and Rabin (2006), I assume an instantaneous utility function of the form

$$u_t \equiv v(x_t) - c(x_{t-1}) + z_t \tag{2.2}$$

where x_t denotes consumption at period t of the good associated with self-control problems and $c(x_{t-1})$ describes the negative consequences of consumption that occurred one period ago. Good x may be a homogeneous good, as in the Ricardian model, or a

[7] The rationale for intervention in the case of negative externalities and information failures and the available policy options are discussed extensively in Jha et al. (2000).

[8] See, for instance, Gruber and Mullainathan (2005), Hersch (2005), and Kan (2007).

[9] Similarly, if something has immediate costs, but generates future benefits, individuals with self-control problems will choose too little of it, a phenomenon that is also known as procrastination. Examples are studying for exams or saving for retirement.

differentiated good, as in the increasing returns to scale and monopolistic competition setting. Utility is quasilinear in z_t, which denotes consumption at period t of a composite good that is not subject to self-control problems and serves as a numéraire. Marginal benefits are assumed to be positive and decreasing, i.e. $v_x > 0$ and $v_{xx} < 0$. Marginal costs are also assumed to be positive, $c_x > 0$, but might be increasing, constant, or decreasing, i.e. $c_{xx} > 0$, $c_{xx} = 0$, or $c_{xx} < 0$, with the additional restriction that $v_{xx} - c_{xx} < 0$ to ensure that consumption is well-behaved.

In contrast to O'Donoghue and Rabin (2006), who allow for marginal utilities and marginal costs to differ across individuals, I abstract from heterogeneity in tastes, since this alone would make trade more beneficial for some persons than for others. Here, I want to focus on the role of differing degrees of self-control for the distributional consequences of trade and thus allow for heterogeneity in the self-control parameter β only. The traditional discount factor δ is assumed to be identical for all individuals, and is set to 1 for simplicity.

With the instantaneous utility function given in (2.2) and $\delta = 1$, the discounted utility at time t of an individual with self-control parameter β can be written as

$$U_t = v(x_t) - c(x_{t-1}) + z_t + \beta \left(v(x_{t+1}) - c(x_t) + z_{t+1} + ... + v(x_T) - c(x_{T-1}) + z_T \right). \quad (2.3)$$

In period t, the individual chooses a consumption allocation for the current period, x_t and z_t, and makes a plan of consumption allocations for all future periods, x_{t+1}, z_{t+1}, ..., x_T, z_T to maximize (2.3) subject to a budget constraint for each period t, $t+1$, ..., T. I assume that in each period an individual supplies one unit of labor inelastically and is paid the equilibrium wage. Borrowings and savings are ruled out, such that in each period total labor income is spent on consumption. Given the additively separable structure of preferences and the absence of borrowings and savings, the consumption decisions of different periods are independent. Hence, in period t, the individual chooses x_t and z_t to maximize $v(x_t) - \beta c(x_t) + z_t$ subject to the period t budget constraint, $p_t x_t + z_t = w_t$. Moreover, she plans to consume x_{t+1} and z_{t+1} in period $t+1$ to maximize $\beta \left(v(x_{t+1}) - c(x_{t+1}) + z_{t+1} \right)$ or, equivalently, $v(x_{t+1}) - c(x_{t+1}) + z_{t+1}$ subject to the period $t+1$ budget constraint, $p_{t+1} x_{t+1} + z_{t+1} = w_{t+1}$. However, once period $t+1$ has arrived, the discounted utility function is U_{t+1}. The individual revises the plans she has made one period ago and now chooses x_{t+1} and z_{t+1} to maximize $v(x_{t+1}) - \beta c(x_{t+1}) + z_{t+1}$ subject to the period $t+1$ budget constraint. Future costs of consumption weigh less heavily than they did one period ago. In principle, unless wages and prices change over time, an individual solves the same optimization problem in each period, and I will omit the time subscript for notational convenience. In each period, the individual chooses current consumption, maximizing $v(x) - \beta c(x) + z \equiv u^*(x, z)$, and makes a plan for future consumption, maximizing $v(x) - c(x) + z \equiv u^{**}(x, z)$, which will be revised one period later.

Given that the preferences of an individual with self-control problems change over time, defining an appropriate welfare criterion is inherently problematic. A common approach in the literature is to evaluate actual choices according to the individual's long-run preferences.[10] These preferences reflect the consumption plan the individual would like to commit to in advance if this was possible. I will follow this approach and measure an individual's welfare by $u^{**}(x,z)$. According to Kahneman (1994), one may interpret $u^{*}(x,z)$ as "decision utility", which governs an individual's consumption choices, and $u^{**}(x,z)$ as "experienced utility", which reflects the subjective well-being the individual derives from these choices. For an individual with time-inconsistent preferences, decision utility and experienced utility diverge, implying that the individual makes consumption choices which are not in her best interest, in the sense that they do not give her the highest possible level of happiness and satisfaction.

In the following section, I will focus on interior solutions to the optimization problem. If (x^*, z^*) is the actual choice maximizing $u^*(x,z)$, this implies that $v_x(x^*) - \beta c_x(x^*) - p = 0$ and $z^* = w - px^*$. Similarly, if (x^{**}, z^{**}) is the ideal choice maximizing $u^{**}(x,z)$, it must be that $v_x(x^{**}) - c_x(x^{**}) - p = 0$ and $z^{**} = w - px^{**}$. From the first order conditions, one can immediately replicate three basic results of O'Donoghue and Rabin (2006). First, for all p and all $\beta < 1$, $x^* > x^{**}$, meaning that people with self-control problems consume more than optimal of the good with immediate benefits and future costs. Second, actual consumption increases as the self-control problem gets worse, $dx^*/d\beta = -c_x(x^*)/-(v_{xx}(x^*) - \beta c_{xx}(x^*)) < 0$. And third, actual consumption increases as the price declines, $dx^*/dp = -1/-(v_{xx}(x^*) - \beta c_{xx}(x^*)) < 0$.

2.4 Ricardian model

I will now incorporate these time-inconsistent preferences into a classic Ricardian two countries, two goods model of international trade. To analyze the welfare effects of trade, I will compare the autarky and the trade equilibrium for consumers with different degrees of self-control in both countries. An example will help to illustrate the results.

2.4.1 Model description

For concreteness, I name the two countries Home and Foreign, and index all variables and parameters by H and F, respectively. I assume that in each period, there is a continuum of individuals with mass L_H in Home and L_F in Foreign. Each individual maximizes her decision utility $u^*(x,z)$ with respect to x and z as described in the previous section.

[10] See for example O'Donoghue and Rabin (1999), O'Donoghue and Rabin (2006), or Gruber and Köszegi (2004). For a discussion of alternative welfare criteria, see Bhattacharya and Lakdawalla (2004).

Individuals within each country differ with respect to their degree of self-control, as described by the cumulative distribution functions $H(\beta)$ and $F(\beta)$. Given that each individual supplies one unit of labor inelastically, total labor supply in each period is L_H in Home and L_F in Foreign. It is used to produce goods x and z according to the following production functions:

$$Q_{iH} = \frac{L_{iH}}{a_{iH}} \text{ and } Q_{iF} = \frac{L_{iF}}{a_{iF}} \text{ with } i = x, z \tag{2.4}$$

where Q_{iH} is the output of good i in country H, L_{iH} is the total amount of labor used in sector i in country H, and a_{iH} are the units of labor needed to produce one unit of good i in country H. Labor is mobile intersectorally, but not internationally, and goods and factor markets are perfectly competitive.

2.4.2 Autarky and trade equilibrium

Since individual decisions at different points in time are independent of one another, and production technologies as well as labor supply do not change over time, the equilibrium allocations and prices will be identical for each period in autarky and for each period under trade, respectively. An autarky equilibrium in Home for any period consists of inputs (L_{xH}, L_{zH}), outputs (Q_{xH}, Q_{zH}), a consumption tuple (x, z) for each individual, and prices (p_H, w_H) such that (i) individual consumption choices are feasible and maximize $u^*(x, z)$, given prices, (ii) firms' input and output choices are feasible and maximize profits, given prices, (iii) labor markets clear, $L_{xH} + L_{zH} = L_H$, and (iv) goods markets clear, $L_H \int x(p_H, w_H, \beta) dH(\beta) = Q_{xH}$ and $L_H \int z(p_H, w_H, \beta) dH(\beta) = Q_{zH}$. The analogous definition applies to Foreign.

A trade equilibrium for any period are inputs, outputs, consumption tuples in both countries, and prices (p, w_H, w_F) such that (i) to (iii) continue to hold in each country, (iv') world goods markets clear, $L_H \int x(p, w_H, \beta) dH(\beta) + L_F \int x(p, w_F, \beta) dF(\beta) = Q_{xH} + Q_{xF}$ and $L_H \int z(p, w_H, \beta) dH(\beta) + L_F \int z(p, w_F, \beta) dF(\beta) = Q_{zH} + Q_{zF}$, and (v) trade is balanced. These equilibrium definitions are those of a classic Ricardian model, with the exception that individuals are heterogeneous in the preferences governing their consumption behavior.

Due to the intersectoral mobility of labor, wages are equalized across sectors within each country. When both goods are produced and consumed in each country in the autarky equilibrium, perfect competition requires that prices equal marginal costs in both sectors in Home and Foreign. With the price of good z being normalized to 1 and p_H^A and p_F^A denoting the autarky equilibrium prices of good x in Home and Foreign, this implies $p_H^A = a_{xH}/a_{zH}$ and $p_F^A = a_{xF}/a_{zF}$. Hence, autarky equilibrium prices are solely determined by production technologies. I assume that Foreign has a comparative advantage in producing good x, meaning that $a_{xH}/a_{zH} > a_{xF}/a_{zF}$. Under this assumption, the

relative price of the good associated with self-control problems is higher in Home than in Foreign in the autarky equilibrium. When borders open up, the relative price of good x in the trade equilibrium, p^T, is bounded by the two autarky prices, $p_F^A \leq p^T \leq p_H^A$.[11] However, trade only has an effect on welfare if the relative price changes. Therefore, I will concentrate on the more interesting case where $p_F^A < p^T < p_H^A$. In this case, each country fully specializes in the production of the good in which it has a comparative advantage and the world supply of good x is L_F/a_{xF}, while the world supply of good z is L_H/a_{zH}.

2.4.3 Welfare effects of trade liberalization

Given that consumption and production decisions in different periods are independent of one another, it is irrelevant in which period trade is liberalized to decide whether an individual benefits from opening up borders. One can simply compare her experienced utility for trade equilibrium choices with her experienced utility for autarky equilibrium choices. The difference may then be interpreted as the per period gain from trade measured in units of the numéraire z. For an individual in Home with self-control parameter β it is

$$G_H = u^{**}(x_H^{*T}, z_H^{*T}) - u^{**}(x_H^{*A}, z_H^{*A}) \tag{2.5}$$

$$= \underbrace{u^*(x_H^{*T}, z_H^{*T}) - u^*(x_H^{*A}, z_H^{*A})}_{\text{traditional gains } (>0)} - \underbrace{(1-\beta)\left(c(x_H^{*T}) - c(x_H^{*A})\right)}_{\text{loss due to increased overconsumption } (>0)} \tag{2.6}$$

with (x_H^{*T}, z_H^{*T}) denoting the individual's decision utility maximizing choice in the trade equilibrium and (x_H^{*A}, z_H^{*A}) denoting her decision utility maximizing choice in the autarky equilibrium. Since $p^T < p_H^A$ and x^* is decreasing in p, $x_H^{*T} > x_H^{*A}$. The first part of equation (6) reflects the traditional gains from trade, which would arise if the consumer had time-consistent preferences and her experienced utility coincided with her decision utility. These gains are unambiguously positive as can be shown with standard revealed preference arguments. The second part of equation (6) only applies if the individual has time-inconsistent preferences and $\beta < 1$. It reflects the fact that the individual does not fully take into account the increase in costs when consuming more of good x in response to the price decline. The resulting inefficiency reduces the traditional gains from trade, and total gains from trade may become negative.

The gains from trade for an individual in Foreign can be obtained by replacing H by F in equations (5) and (6). As for an individual in Home, they can be divided into a traditional part and a component that is due to the self-control problem. The traditional

[11] Recall that individual and thus aggregate demand for good x is decreasing in p. For $p^T < p_F^A$, production of good x would fall to zero in both countries while demand would increase relative to the autarky equilibrium, resulting in excess demand. Similarly, for $p^T > p_H^A$, production of good x would rise while demand would decrease, resulting in excess supply.

part is again positive. In contrast to the Home country, however, the second component is negative. This is because the relative price of the good associated with self-control problems rises in Foreign compared to autarky, $p^T > p_F^A$, and consumption declines, $x_F^{*T} < x_F^{*A}$. Trade effectively mitigates the self-control problem by reducing the costs that cause inefficient consumption since they are not fully taken into account. Thus, the total gains from trade for any individual in Foreign are unambiguously positive, no matter whether the individual suffers from self-control problems or not. Summing up, if there exists an autarky equilibrium and a trade equilibrium in which Home specializes in the production of good z and Foreign specializes in the production of good x, and if each individual consumes both goods x and z in autarky and under trade, which I will assume throughout, then the following is true:

Proposition 2.1

1. *If the individual lives in Home, she gains from trade for $\beta = 1$ and may gain or lose from trade for $\beta < 1$.*

2. *If the individual lives in Foreign, she gains from trade for all $\beta \leq 1$.*

When are consumers in Home more likely to lose from trade? Some comparative static helps to answer this question. First, an important determinant of the benefits from trade liberalization is the degree of self-control. Yet, a larger self-control problem does not necessarily imply that an individual is more likely to lose. The derivative

$$\frac{\partial G_H}{\partial \beta} = -(1-\beta)\left(c_x(x_H^{*T})\frac{\partial x_H^{*T}}{\partial \beta} - c_x(x_H^{*A})\frac{\partial x_H^{*A}}{\partial \beta}\right) \tag{2.7}$$

suggests that it depends on how strongly individuals with different degrees of self-control react to the price reduction from p_H^A to p^T. If consumers with low self-control are more price responsive than those with high self-control, their problem of overconsumption gets worse more than it does for those with high self-control, and they experience a smaller gain or a larger loss in utility, respectively. Consumers with lower self-control are more price responsive if the following assumption is satisfied:

Assumption 2.1 *For all x, $2c_{xx}(v_{xx} - \beta c_{xx}) < c_x(v_{xxx} - \beta c_{xxx})$.*

It is sufficient for $c_x(x^*)\partial x^*/\partial\beta$ to be decreasing in x^* and thus for the gains from trade in Home to be increasing in β. Assumption 2.1 is satisfied for most commonly used utility functions when costs are linear or quadratic, e.g. for log utility and linear costs.[12]

[12] Assumption 2.1 is not satisfied e.g. for quadratic utility and linear costs, $v(x) = -b(x-a)^2$ with $b > 0$, $a > 0$ and $c(x) = cx$. In this case, demand functions for good x are linear, and the slope is independent of β. Hence, as the price of good x falls, individuals with low self control consume more to the same extent as individuals with high self-control do and thus make the same gains from trade.

Analogously, if individuals in Foreign with low self-control are more price responsive than those with high self-control, they benefit more from the price increase from p_F^A to p^T, as they reduce their overconsumption more than those with high self control do. Therefore, assumption 2.1 is also sufficient for the gains from trade in Foreign to be decreasing in β.

Proposition 2.2 *If assumption 2.1 is satisfied, $\partial G_H/\partial\beta > 0$ and $\partial G_F/\partial\beta < 0$, that is in Home individuals with higher self-control gain more from trade, while in Foreign individuals with lower self-control gain more from trade.*

In the optimal taxation framework of O'Donoghue and Rabin (2006), the same assumption is sufficient for small taxes on good x to create Pareto-improvements if the tax proceeds are redistributed in a lump-sum fashion and individuals differ only with respect to β. This is not surprising, given that in a Ricardian setting a tax and trade liberalization have the same effect in the Home country: they both change the relative price p, albeit in opposite directions. When a small tax is levied and individuals with self-control problems are sufficiently price responsive, the price hike helps them to reduce their overconsumption, and this effect outweighs their loss in real income. When trade is liberalized and individuals with self-control problems are sufficiently price responsive, the decline in price exacerbates their overconsumption, thus reducing their gains in real income. If all individuals were forced to bear an equal share of the hypothetical costs that would arise if the government wanted to guarantee trade prices in an autarky situation by subsidizing good x, then everybody in Home would be weakly worse off under free trade. However, these costs do not have to be borne under free trade, and thus at least those individuals with $\beta = 1$ are better off.

Whether and by how much an individual benefits from trade also depends on the extent to which the trade price differs from the autarky price. The trade price is determined through supply and demand in general equilibrium, and thus depends on population size, technology, and the distribution of preferences. With $G(\beta)$ denoting the world distribution of β and p^T denoting the corresponding trade price, one gets the following result:

Lemma 2.1

1. *The equilibrium price p^T is decreasing in L_F and increasing in L_H and a_{xF}.*
2. *For any two distribution functions $G'(\beta)$ and $G(\beta)$ with $G'(\beta) \geq G(\beta)$ for all β, $p^{T'} \geq p^T$.*

An increase of the population in Foreign which leaves the distribution $F(\beta)$ unaffected decreases the equilibrium price, because it increases aggregate supply more than aggregate demand. An increase of the population in Home, however, only increases aggregate

demand, and thus leads to a higher equilibrium price. Furthermore, as a_{xF} increases, production of good x gets less efficient and the equilibrium price rises, all other things being equal. This simply follows from totally differentiating the goods market clearing condition $L_H \int x(p^T, \beta)dH(\beta) + L_F \int x(p^T, \beta)dF(\beta) = L_F/a_{xF}$. Note that the demand for good x is independent of income for an interior solution because of the quasilinear structure of preferences. Using that the world distribution of β is the weighted sum of the distributions in Home and Foreign, $G(\beta) = (L_H H(\beta) + L_F F(\beta))/(L_H + L_F)$, the goods market clearing condition can be rewritten as $(L_H + L_F) \int x(p^T, \beta)dG(\beta) = L_F/a_{xF}$. When the distribution changes from $G(\beta)$ to $G'(\beta)$ such that more people have less self-control, aggregate demand increases, and ceteris paribus the equilibrium price must rise.

Knowing how the equilibrium price p^T depends on the parameters of the model, the next step is to analyze how it affects the individual gains from trade.

Proposition 2.3

1. *If the individual lives in Home and has $\beta = 1$, her gains are decreasing in p^T. If she has $\beta < 1$, her gains are decreasing in p^T if and only if $-x_H^{*T} < (1-\beta)c_x \frac{\partial x_H^{*T}}{\partial p^T}$.*

2. *If the individual lives in Foreign, her gains are increasing in p^T for all $\beta \leq 1$.*

In Home, a smaller equilibrium price p^T has two effects. It increases the traditional gains from trade as the imported good becomes cheaper, but it also worsens the inefficiency due to overconsumption for those individuals who suffer from self-control problems, as can be seen from the derivative $\partial G_H/\partial p^T = -x_H^{*T} - (1-\beta)c_x \partial x_F^{*T}/\partial p^T$. For an individual with $\beta < 1$, both effects work into opposite directions, and the gains from trade are only decreasing in p^T if the traditional effect dominates the overconsumption effect. Overall, the relationship between G_H and p^T does not need to be monotonic. Like in the example in section 2.4.4, it may happen that the gains from trade for an individual with self-control problems first rise as p^T falls, and then decline as p^T moves further away from the autarky price. For an individual with $\beta = 1$, the overconsumption effect vanishes and $\partial G_H/\partial p^T = -x_H^{*T} < 0$.

In Foreign, both effects work in the same direction, as can be seen from the derivative $\partial G_F/\partial p^T = \left(1/a_{xF} - x_F^{*T}\right) - (1-\beta)c_x \partial x_F^{*T}/\partial p^T$. A larger equilibrium price p^T increases the traditional gains from trade as the exported good becomes more expensive,[13] and it reduces the inefficiency due to overconsumption. Thus, the gains from trade unambiguously rise with p^T for all individuals in Foreign.

[13]Note that $z_F^{*T} = w_F^T - p^T x_F^{*T} = p^T/a_{xF} - p^T x_F^{*T} = p^T\left(1/a_{xF} - x_F^{*T}\right)$, using that marginal costs must equal the price in equilibrium, $w_F^T a_{xF} = p^T$. Hence, in a trade equilibrium where individual consumption of z is positive and the individual welfare analysis in this chapter applies, it must be that $1/a_{xF} - x_F^{*T} > 0$.

One may not only be interested in the individual gains from trade, but also in the gains from trade for a country as a whole. However, without assuming a specific utility and cost function and a particular distribution of β, it is difficult to make any statement about the sign and the size of a country's gains from trade, at least for Home. Clearly, if all individuals in Home are fully self-controlled, the country's gains from trade are positive. Taking this as a starting point, one can think about what happens if more and more individuals in Home suffer from self-control problems. This has two effects: First, the equilibrium price p^T rises, and second, the gains of individuals with lower β weigh more heavily. A rising price unambiguously hurts those who are still fully self-controlled, and given that individuals with self-control problems can never make higher gains than those who are fully self-controlled as long as assumption 2.1 is satisfied, the country's gains from trade cannot rise as one moves from a situation with no self-control problems to a situation where at least some individuals in Home have self-control problems. Yet, comparing two different distributions of self-control problems in Home is impossible without further information due to the fact that individuals with low self-control may actually benefit from a rising price. The Foreign country's gains from trade are always positive, and if assumption 2.1 is satisfied, they are the higher the more individuals in Foreign suffer from self-control problems.

However, even if the Home country's gains from trade are negative, trade can be made a Pareto-improvement. The government in Home just has to introduce a tariff on the imported good x such that the consumer price under trade equals the autarky price, and redistribute the tariff revenue in a lump sum fashion. In this case, the traditional gains due to specialization are preserved, and losses due to increased overconsumption are avoided. Thus, Pareto-gains from trade are possible, but they require government action. Also note that a tariff on the sin good will reduce the equilibrium price in Foreign, thereby reducing the gains that can be achieved abroad.

To illustrate the results derived in this section and to give an idea of how large the gains or losses due to trade liberalization may in fact be, I will provide an example with a concrete utility and cost function and feasible parameter values in the following section.

2.4.4 Example

Suppose $v(x) = 2\sqrt{x}$ and $c(x) = x$ for all individuals in Home and Foreign. Then the interior solution to the decision utility maximization problem is $x^* = 1/(\beta + p)^2$ and $z^* = w - p/(\beta + p)^2$. Using the equilibrium prices and wages in autarky and under trade, an individual's gains from trade in Home and Foreign can be calculated as

$$G_H = \left(\frac{1}{(\beta + p^T)} - \frac{1}{(\beta + \frac{a_{xH}}{a_{zH}})} \right) - (1 - \beta) \left(\frac{1}{(\beta + p^T)^2} - \frac{1}{(\beta + \frac{a_{xH}}{a_{zH}})^2} \right) \tag{2.8}$$

$$G_F = \left(\frac{1}{(\beta + p^T)} - \frac{1}{(\beta + \frac{a_{xF}}{a_{zF}})} + \frac{p^T}{a_{xF}} - \frac{1}{a_{zF}} \right) - (1-\beta) \left(\frac{1}{(\beta + p^T)^2} - \frac{1}{(\beta + \frac{a_{xF}}{a_{zF}})^2} \right). \quad (2.9)$$

The first part of each equation reflects the traditional gains, which are unambiguously positive if each country fully specializes in its comparative advantage good and the individual consumes both goods x and z in autarky and under trade. The second part describes the change in welfare due to a change in overconsumption, which is negative in Home and positive in Foreign. Thus, in Foreign, all individuals unambiguously gain from trade, while in Home, individuals with self-control problems may lose from trade if the traditional gains are overcompensated by the welfare loss due to increased overconsumption. Whether this will actually happen depends on the individual's self-control parameter β and on the equilibrium price p^T, which solves the goods market clearing condition and depends on the distribution of β in Home and in Foreign, the population sizes L_H and L_F and the technology parameter a_{xF}.

I assume that the self-control parameter β is uniformly distributed on the interval $[0.4, 1]$ in Home and in Foreign. Empirical evidence on the distribution of the self-control parameter β is still limited. Most studies that estimate models with hyperbolic discounting estimate a single β for the whole sample. For instance, Laibson et al. (2007) use a consumption-savings model and estimate a β of about 0.7. Shui and Ausubel (2005) take the results of an experiment in the credit-card market and estimate a present-bias factor of 0.8, while Fang and Silverman (2007) implement a model of labor supply and welfare participation and get an estimate for β of about 0.34. An exception is Paserman (2008), who estimates the degree of hyperbolic discounting in a job search model for different groups of workers. His estimate for β is 0.4 for low income workers (1st quartile of the wage distribution), 0.48 for medium income workers (2nd and 3rd quartile of the wage distribution), and 0.89 for high income workers (4th quartile of the wage distribution). To sum up, even though most studies cannot reject the hypothesis that individuals are hyperbolic discounters, the estimates vary considerably depending on the model used and the assumptions made, and information about the distribution of β that go beyond its mean are scarce. Therefore, a uniform distribution of β on $[0.4, 1]$ with mean 0.7 does not seem to be implausible.

The remaining parameter values have to be chosen such that (i) Foreign has a comparative advantage in good x, (ii) the equilibrium price lies between the two autarky prices p_F^A and p_H^A, and (iii) each individual with $\beta \in [0.4, 1]$ in Home and Foreign has strictly positive demand for x and z in autarky and under trade. One set of parameter values that satisfies conditions (i) to (iii) is $L_H = 6$, $a_{xH} = 0.3$, $a_{zH} = 0.4$, $L_F = 1$, $a_{xF} = 0.2$ and $a_{zF} = 0.4$.

For these parameter values, the gains from trade in Home and Foreign for individuals with different degrees of self-control are displayed in figure 2.1. To ease interpretation, they are indicated in percent of the individual's experienced utility in autarky. A fully

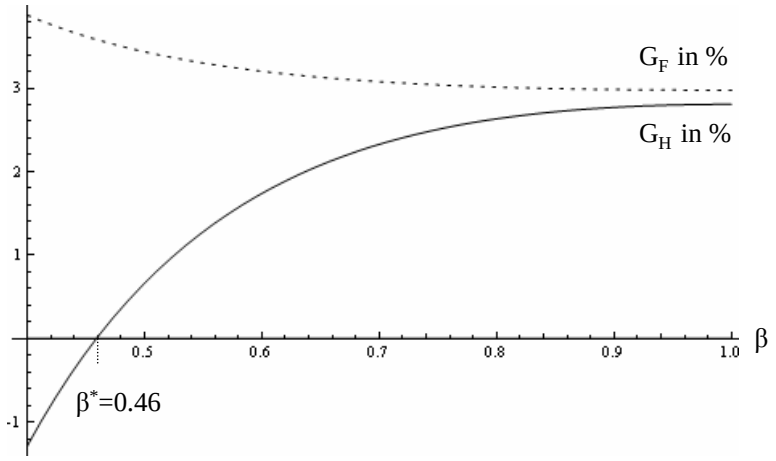

Figure 2.1: Individual gains in Home and Foreign

self-controlled individual in Home gains about 2.8% from trade. In other words, free trade allows an individual with $\beta = 1$ to increase consumption of the composite good by about 2.8%, all else being equal. The welfare gains are the lower, the stronger is the self-control problem: an individual with $\beta = 0.6$ gains only about 1.6% from trade. For an individual with $\beta = \beta^* = 0.46$, the loss due to increased overconsumption and the traditional gains exactly compensate, and an individual at the lower end of the distribution loses by more than 1.2%. Given that the chosen utility function satisfies assumption 2.1, it is not surprising that the individual gains from trade in Home are increasing in β. In Foreign, the individual gains from trade are positive and decreasing in β for all $\beta \in [0.4, 1]$. A fully self-controlled individual can consume about 3% more of the composite good under trade than in autarky, while an individual at the lower end of the distribution gains more than 3.8% from trade.

In addition to the self-control parameter β, the equilibrium price under trade is crucial for an individual's gains from trade. While the gains from trade are decreasing in p^T for a fully self-controlled individual in Home, the relationship is non-monotonic for individuals with low self-control. Their gains, measured in percent of autarky experienced utility, increase if the equilibrium price under trade falls only slightly below the autarky price in Home, but decrease and eventually become negative if p^T declines further, which happens, for instance, if the population in Foreign grows.[14]

[14]For the given parameter values with $L_F = 1$, the equilibrium price is $p^T = 0.52$, and at this price the gains from trade for an individual with $\beta = \beta^* = 0.46$ have fallen to zero.

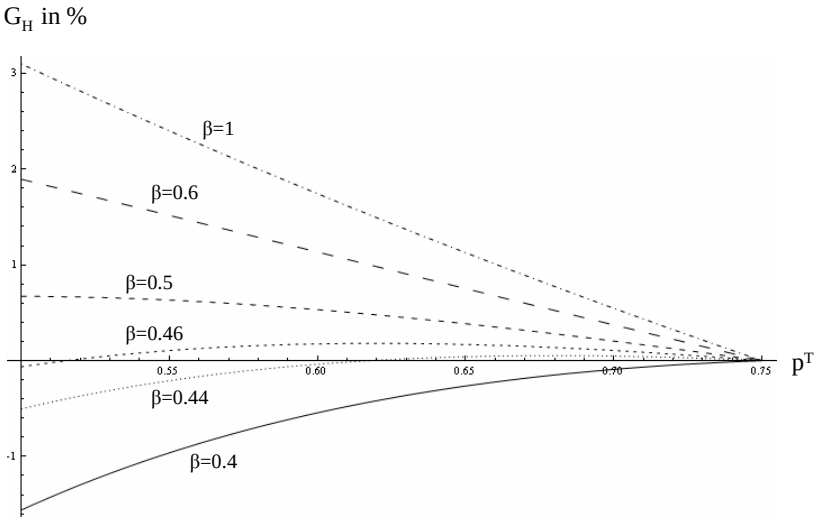

Figure 2.2: Individual gains in Home for different β as a function of p^T.

Finally, with a uniform distribution of the self-control parameter β, the gains from trade for a country as a whole are proportional to the area under the respective curve in figure 2.1. In this specific example, they are positive in both Home and Foreign.

2.5 New trade model

In the previous section, I have demonstrated that in a Ricardian model of trade with constant returns to scale, perfect competition and time-inconsistent preferences, the welfare consequences of trade crucially depend on the direction of trade. While individuals in the country exporting the sin good unambiguously gain, individuals in the importing country may lose. I will now turn to a new trade model, characterized by increasing returns to scale and monopolistic competition, and show that in such a framework the welfare implications might be different. First, individuals in both countries may lose from trade, and second, even fully self-controlled individuals may lose if there is heterogeneity in the degree of self-control across countries.

2.5.1 Model description

Individuals have time-inconsistent preferences for two goods as described in section 2.3, with the exception that good x is now a differentiated good with a continuum of varieties. I denote consumption of variety i by $x(i)$, with $i \in [0, N]$. N is the mass of varieties and is determined endogenously. As before, I denote consumption of the composite numéraire good by z. In each period, an individual supplies l units of labor inelastically and gets a

labor income of wl. Hence, in each period, an individual chooses $x(i)$, $i \in [0, N]$, and z to maximize her decision utility $u^*(x(i), i \in [0, N], z) = v(x(i), i \in [0, N]) - \beta c(x(i), i \in [0, N]) + z$ subject to the budget constraint $\int_0^N p(i)x(i)di + z = wl$. Her welfare is measured in terms of experienced utility, $u^{**}(x(i), i \in [0, N], z) = v(x(i), i \in [0, N]) - c(x(i), i \in [0, N]) + z$.

To make the model analytically tractable, I assume a specific functional form for $v(\cdot)$ and for $c(\cdot)$, i.e.

$$u^*(x(i), i \in [0, N], z) = \underbrace{\alpha \int_0^N x(i)di - \frac{1}{2}\rho \int_0^N x(i)^2 di - \frac{1}{2}\eta \left(\int_0^N x(i)di \right)^2}_{v(x(i), i \in [0,N])} - \beta \underbrace{\gamma \int_0^N x(i)di}_{c(x(i), i \in [0,N])} + z \tag{2.10}$$

with $\alpha > 0$ and $\rho > \eta > 0$. Similar functional forms for $v(\cdot)$ have been used for example by Ottaviano et al. (2002) and Melitz and Ottaviano (2008). The parameter α reflects the intensity of preferences for the differentiated good relative to the composite good, while $\rho > \eta$ implies that the individual likes to spread consumption of good x over as many varieties as possible. This love of variety is the greater, the higher is ρ. For a given value of ρ, η describes the substitutability between varieties. They are the closer substitutes, the higher is η. For the future costs of consumption, only the total amount of the differentiated good matters. It is irrelevant how this amount is split between the different varieties. To give an intuition for this assumption, note that for the probability of getting lung cancer, it certainly matters how much an individual smokes. It seems however secondary whether she smokes Marlboro, Camel or Lucky Strike cigarettes. Similarly, whether an individuals becomes obese and suffers from diabetes might depend on how many bars of chocolate she eats per day. Whether this is milk chocolate or white chocolate is however less important.

I assume that labor supply and thus income are sufficiently large and that the preference for the differentiated good is sufficiently strong, such that all individuals have positive demand for each variety $i \in [0, N]$ and for the composite good.[15] In this case, the demand of an individual with self-control parameter β for each variety $i \in [0, N]$ is given by

$$x(i) = \frac{\alpha - \beta\gamma}{\rho + \eta N} + \frac{\eta N \bar{p}}{\rho(\rho + \eta N)} - \frac{p(i)}{\rho} \tag{2.11}$$

with $\bar{p} = \frac{1}{N} \int_0^N p(i)di$ being the average price of the differentiated good.

[15] Assumption 2.2 imposes restrictions on the parameters of the model which ensure that this will indeed be the case in equilibrium.

For the moment, I focus on a single country and assume that it is populated by a continuum of individuals with mass L. These individuals may differ in their degree of self-control, as described by the cumulative distribution function $H(\beta)$. If all individuals in the support of $H(\beta)$ have a positive demand as given by equation (2.11), the aggregate demand for each variety $i \in [0, N]$ is

$$X(i) = L\left(\frac{\alpha - \bar{\beta}\gamma}{\rho + \eta N} + \frac{\eta N \bar{p}}{\rho(\rho + \eta N)} - \frac{p(i)}{\rho}\right) \tag{2.12}$$

where $\bar{\beta} = \int \beta dH(\beta)$ is the average β in the population.

As in the previous section, the numéraire good z is produced with constant returns to scale under perfectly competitive conditions. The units of good z are normalized such that producing one unit of good z requires one unit of labor. This implies an equilibrium wage of $w = 1$. Each variety $i \in [0, N]$ of the differentiated good is produced by a single firm with zero marginal costs and fixed costs F. The firm chooses $p(i)$ to maximize profits, $\Pi(i) = p(i)X(i) - F$, taking the average price $\bar{p}$ of the differentiated good and the number of firms N as given. This is a central feature of monopolistic competition: since there is a continuum of competitors, each firm has a negligible effect on the market, and there is no direct strategic interaction. There is only indirect interaction through the average price $\bar{p}$, which influences the aggregate demand for the differentiated good and thus for each variety. Another central feature of monopolistic competition, which is assumed in the following, is free entry and exit of firms.

2.5.2 Autarky equilibrium

The definition of an autarky equilibrium is analogue to the one given in section 2.4.2, with the exception that inputs, outputs and consumption allocations as well as prices are now defined for each variety $i \in [0, N]$ of the differentiated good. Also, the market clearing condition must hold for each variety $i \in [0, N]$. Like prices, N is taken as given by individuals and firms and will be determined endogenously in equilibrium as firms can freely enter and exit the market.

Since the different varieties enter symmetrically into the utility function (2.10) and firms have identical marginal costs of zero, each firms chooses the same profit maximizing price, which depends on the number of competitors as well as on the average price for the differentiated good,

$$p(i) = \frac{\rho(\alpha - \bar{\beta}\gamma) + \eta N \bar{p}}{2(\rho + \eta N)} \text{ for all } i \in [0, N]\,. \tag{2.13}$$

Intuitively, if N increases, competition becomes fiercer, and the firm must lower its price. If $\bar{p}$ rises, substitutes become more expensive, and the firm can charge a higher price

for its own product. This effect is the stronger, the closer are the substitutes. Due to symmetry, $\bar{p} = p(i) = p$ and (2.13) collapses to

$$p = \frac{\rho(\alpha - \bar{\beta}\gamma)}{2\rho + \eta N}. \tag{2.14}$$

Aggregate demand for each variety at the profit maximizing price then is

$$X = L\frac{\alpha - \bar{\beta}\gamma}{2\rho + \eta N}. \tag{2.15}$$

With free entry, firms must make zero profits in equilibrium, $\Pi = pX - F = 0$. Substituting in (2.14) and (2.15) and solving for N gives

$$N^* = \frac{(\alpha - \bar{\beta}\gamma)\sqrt{\frac{\rho L}{F}} - 2\rho}{\eta}. \tag{2.16}$$

The equilibrium mass of varieties increases if the intensity of preferences for the differentiated good rises, if the average degree of self-control decreases, or if the population size increases. All this might be interpreted as an increase in market size. Increasing fixed costs however reduce the equilibrium mass of varieties. If they get too large relative to market size, N will be zero in equilibrium. Plugging (2.16) back into (2.14) and (2.15) gives the equilibrium price of each variety $i \in [0, N]$

$$p^* = \sqrt{\frac{\rho F}{L}} \tag{2.17}$$

and the equilibrium aggregate consumption of each variety $i \in [0, N]$

$$X^* = \sqrt{\frac{LF}{\rho}}. \tag{2.18}$$

Note that both the equilibrium price and aggregate consumption of each variety are independent of the average degree of self-control, $\bar{\beta}$. They only depend on fixed costs F, the parameter ρ, and the population size L. Individual consumption of each variety will be a fraction L of aggregate consumption, corrected by a factor that accounts for deviations from the average degree of self-control,

$$x^* = \frac{\sqrt{\frac{LF}{\rho}}\left((\alpha - \beta\gamma)\sqrt{\frac{\rho L}{F}} - \rho\right)}{L\left((\alpha - \bar{\beta}\gamma)\sqrt{\frac{\rho L}{F}} - \rho\right)}. \tag{2.19}$$

In equilibrium, an individual who has higher self-control than the average consumes less of the sin good than the average, and vice versa. To ensure that all demands as well as the equilibrium mass of varieties are positive and equations (2.16) to (2.19) indeed characterize an autarky equilibrium, I make the following assumption:

Assumption 2.2 *For all β in the support of $H(\beta)$, the parameters of the model satisfy the following conditions:*

1. $\frac{l\eta}{\sqrt{\frac{\rho F}{L}}} > \alpha - \beta\gamma > \sqrt{\frac{\rho F}{L}}$
2. $\alpha - \bar{\beta}\gamma > 2\sqrt{\frac{\rho F}{L}}$

The first condition ensures that $x^* > 0$ and $z^* = l - N^* p^* x^* > 0$. The second parameter restriction guarantees that the equilibrium mass of varieties is positive. All conditions can be satisfied if the fixed costs are sufficiently small relative to the intensity of preferences for the differentiated good and if the individual labor supply is sufficiently large.

The experienced utility in the autarky equilibrium, which depends on the individual degree of self-control, is then given by

$$u^{**} = \underbrace{N^* x^* \frac{1}{2}(\alpha - \beta\gamma - p^*) + l}_{\text{traditional part}} - \underbrace{(1-\beta)\gamma N^* x^*}_{\text{loss due to overconsumption}} . \tag{2.20}$$

Similar to the Ricardian setting, it can be split into two parts, a traditional one and one which reflects the reduction of well-being due to overconsumption and cancels for $\beta = 1$.

2.5.3 Welfare effects of trade liberalization

How to think about trade liberalization within this framework? The traditional way is to look at two economies with identical preferences and production technologies and interpret trade simply as an increase in the mass of consumers L that can be reached by each firm. As borders open up, producers in both countries can serve the domestic and the foreign market and take advantage of economies of scale in production. The equilibrium price falls. At the same time, individuals in both countries gain access to more varieties. Even though they consume less of a single variety, their overall consumption of the differentiated good increases. Both the decreasing price and the increasing choice benefit the fully self-controlled individuals. The traditional part of the experienced utility is decreasing in p^* and increasing in $N^* x^*$. Those individuals who suffer from self-control problems may however be worse off in both countries, since they do

not correctly take into account the increasing costs of consuming more of the differentiated good, and their loss due to increased overconsumption may overcompensate their conventional gains from trade.

Within the present framework, however, trade does not only have an impact on the size of the market that is served by each firm. Given that already individuals within one country are heterogeneous in their degree of self-control, it is very likely that the two trading countries are characterized by different cumulative distribution functions. And unless both cumulative distribution functions have the same mean, the average degree of self-control in the open economy $\bar{\beta}^T$ will be different from the average degrees of self-control in the two closed economies. If the average self-control problem is more severe in Foreign than in Home, that is $\bar{\beta}_F < \bar{\beta}$, then $\bar{\beta}^T$ will be smaller than $\bar{\beta}$. A smaller average degree of self-control has a positive effect on aggregate demand, all else equal. As a result, more varieties become available, and the total amount of the differentiated good an individual in Home consumes increases. The effect of a decrease in the average degree of self-control thus goes into the same direction as the effect of an increase in market size. It benefits the fully self-controlled individuals in Home, while it may hurt individuals with low self-control. However, if the average self-control problem is less severe in Foreign than in Home, that is $\bar{\beta}_F > \bar{\beta}$, then $\bar{\beta}^T$ will be larger than $\bar{\beta}$, and considered in isolation, this hurts the fully self-controlled individuals in Home, while it may benefit those individuals that lack willpower. In combination with an increase in the mass of consumers, the welfare consequences of trade are much more ambiguous and depend on which of the two opposing effects dominates. Nevertheless, if $\bar{\beta}^T$ is smaller than or equal to $\bar{\beta}$, one can find a sufficient condition for the individual gains from trade in Home to be positive.

Proposition 2.4 *Consider an individual with self-control parameter β living in a country in which the average degree of self-control is $\bar{\beta}$. Suppose assumption 2.2 is satisfied in autarky. If the country starts trading with another country in which the average degree self-control is equal to or lower than $\bar{\beta}$, the individual gains from trade if $\beta \geq 2 - \frac{\alpha - \sqrt{\frac{\rho F}{L}}}{\gamma}$.*

For a proof, see the appendix. Thus, individuals with sufficiently strong self-control gain from trade, provided that the average degree of self-control is not higher in the country they start trading with than in their own country. Their gains increase with the size of the population in the foreign country. What the finding also suggests is that individuals with low self-control can lose from trade, and for this to happen, it is irrelevant in which of the two trading countries they live in if both countries are characterized by similar distributions of self-control. In other words, with increasing returns to scale and monopolistic competition, individuals with low self-control may lose from trade in both countries, in contrast to the Ricardian setting, where at most individuals with low self-control in the importing country can be worse off as borders open up. Another novelty compared to the Ricardian setting is that a changing average degree of self-control opens

up the possibility that in at most one country even the fully self-controlled individuals lose from trade. The intuition behind this result is that if a country opens up its borders to a country in which the average degree of self-control is very high and hence demand for the sin good is rather low, firms have to reduce their prices considerably to capture these new consumers. Since firms cannot price discriminate across countries, their revenues fall despite a larger market size. This effect leads to less firms and hence less varieties in the trade equilibrium, which hurts the fully self-controlled individuals. [16] However, numerical simulations indicate that the conditions for this to actually happen are rather restrictive. In fact, the fully self-controlled individuals in Home can only lose if the average degree of self-control in Foreign exceeds one, implying that the individuals in Foreign are overly self-controlled and rather have a problem of underconsumption than one of overconsumption, possibly not consuming the differentiated good at all in autarky. Just to give an example, $\alpha = 15$, $\gamma = 10$, $\bar{\beta} = 0.75$, $L = 15$, $\eta = 10$, $\rho = 20$, $F = 10$, and $l = 2$ is a set of parameter values that satisfies assumption 2.2. If in Foreign the average degree of self-control is $\bar{\beta}_F = 1.2$ and the population size is $L_F = 10$, then the average degree of self-control in the open economy is $\bar{\beta}^T = 0.93$, and the total population is $L^T = 25$, implying that assumption 2.2 continues to hold under trade. For these parameter values, a fully self-controlled individual in Home loses about 0.06% from trade in terms of experienced utility, or, to put it differently, in terms of consumption of the numéraire good. Hence, even if the parameter values are such that losses indeed occur, they are quantitatively negligible, in particular if the expenditure on the differentiated good represents only a small fraction of income, that is if l is large. If the average degree of self-control is smaller than or equal to one in both Home and Foreign, the fully self-controlled individuals on both sides of the border always gain from trade. Given the empirical evidence on the distribution of self-control problems summarized in section 2.4.4, this seems to be the more probable scenario.

2.6 Conclusion

The present paper has analyzed the consequences of time-inconsistent preferences for the welfare effects of trade liberalization within two different trade models. In a classic Ricardian model with constant returns to scale and perfect competition, it crucially depends on the direction of trade whether an individual is better or worse off as borders open up. In the exporting country, all individuals are better off, and they are the

[16] Note that the negative effect of trade liberalization on the number of varieties is not specific to a situation in which there is heterogeneity across countries in the degree of self-control, but may occur more generally whenever there is heterogeneity across countries in the preferences for the differentiated good, as captured by α, or in the future costs of consumption, as reflected by γ. Opening up borders to a country in which the average preference for the differentiated good is relatively low or the average future cost of consumption is comparatively high can also lead to less firms and less varieties, and hence make individuals in the country with high demand for the differentiated good worse off.

better off, the higher is the equilibrium price of the sin good and the lower is their degree of self-control. In the importing country however, while the fully self-controlled individuals gain from trade, those individuals with self-control problems may lose from trade, and this is more likely, the stronger is their self-control problem, provided that they are sufficiently price-sensitive. These findings are however sensitive to changes in the assumptions on production technology and market structure. In a new trade model with increasing returns to scale and monopolistic competition, the equilibrium price falls and the variety of products available to consumers rises in both countries as borders open up, provided that the average degrees of self-control in the two countries are similar. A lower price and a larger variety benefit the fully self-controlled individuals, while they may hurt consumers with a lack of willpower in both countries. Yet, the welfare consequences are much more ambiguous if the distribution of self-control problems is heterogeneous across countries. In particular, if a country starts trading with another country which is inhabited by overly self-controlled individuals, then the fully rational individuals lose if the negative effect of a rising average degree of self-control on the available product variety dominates the positive effect of an increasing market size, while the individuals with a lack of willpower may gain.

One real world example where self-control problems matter for the welfare effects of trade and where government action is required to make trade a Pareto-improvement over autarky is the case of trade in cigarettes. The empirical evidence on self-control problems with regard to smoking is strong, and the effects of trade on the consumption of cigarettes as well as the health consequences are well documented. Yet, the analysis also qualifies for trade in other goods, such as unhealthy food, as mentioned in the beginning, or alcohol. For instance, after Sweden joined the European Union in 1995, it gradually liberalized trade in alcohol. The result were falling prices and an increased variety, which are partly responsible for an upsurge in alcohol abuse in Sweden (Daley, 2001). Similarly, when Finland opened up its borders to Estonia in 2004 within the framework of the expansion of the European Union, nearly unlimited amounts of low priced alcohol became available, with adverse effects on Finish public health (Finish Ministry of Social Affairs and Health, 2006).

The preceding analysis suggests that in all of these cases, the welfare effects of trade liberalization may be less positive than traditional models suggest. It provides a first hint at which factors actually matter for the distribution of the gains from trade across individuals and across countries when individuals have self-control problems and can serve as a point of reference for policy recommendations.

Certainly, the analysis can be refined. So far, I have abstracted away from heterogeneity in tastes, and this may be an important determinant of whether taxes or tariffs are Pareto-improving, as O'Donoghue and Rabin (2006) have shown. Possible extensions of the model include the introduction of income effects, in combination with borrowings and savings. Such effects might be rather irrelevant for smoking, but they are certainly

important for more expensive goods such as illicit drugs. Including income effects does however make a welfare analysis with time-inconsistent agents an even more serious issue, given that utility units cannot simply be expressed in terms of income or a numéraire good. An alternative way to connect different periods of time is to remove the functional separability between immediate benefits and future costs. This is for example what Gruber and Köszegi (2004) do when they analyze the welfare effects of taxes on addictive goods. If consumption decisions of different periods are connected, it matters whether individuals are aware of their self-control problem or not, and this may have interesting implications also for trade. In addition, the connection between different periods of time opens up the possibility for intertemporal trade, and this also seems worth to analyze. Finally and most importantly, more empirical research is needed, especially with respect to the distribution of the self-control parameter β within a population and across countries, to determine how many individuals lose, and what is the magnitude of their losses. To conclude, there is much need and room for further research, empirical as well as theoretical, and taking into account new insights from behavioral economics in international trade theory promises new results.

Appendix

Appendix A: Proof of proposition 2.4

Note that if assumption 2.2 is satisfied in autarky, i.e. for $\bar{\beta}$ and L, it will also be satisfied under trade, i.e. for $\bar{\beta}^T = \frac{\bar{\beta}L + \bar{\beta}_F L_F}{L + L_F} \leq \bar{\beta}$ and $L^T = L + L_F \geq L$ where $\bar{\beta}_F$ and L_F denote the average degree of self-control and the mass of consumers in the foreign country, respectively. Then the gains from trade for an individual with self-control parameter β are

$$\begin{aligned} G &= \frac{\left(\alpha - \bar{\beta}^T\gamma - 2\sqrt{\frac{F\rho}{L^T}}\right)\left(\alpha - \beta\gamma - \sqrt{\frac{F\rho}{L^T}}\right)\left(\alpha - \beta\gamma - \sqrt{\frac{F\rho}{L^T}} - 2(1-\beta)\gamma\right)}{2\eta\left(\alpha - \bar{\beta}^T\gamma - \sqrt{\frac{F\rho}{L^T}}\right)} \\ &\quad - \frac{\left(\alpha - \bar{\beta}\gamma - 2\sqrt{\frac{F\rho}{L}}\right)\left(\alpha - \beta\gamma - \sqrt{\frac{F\rho}{L}}\right)\left(\alpha - \beta\gamma - \sqrt{\frac{F\rho}{L}} - 2(1-\beta)\gamma\right)}{2\eta\left(\alpha - \bar{\beta}\gamma - \sqrt{\frac{F\rho}{L}}\right)} \end{aligned} \tag{2.21}$$

The derivative of G with respect to $\bar{\beta}_F$ is

$$\frac{\partial G}{\partial \bar{\beta}_F} = -\frac{L_F\gamma\sqrt{\frac{F\rho}{L^T}}\left(\alpha - \beta\gamma - \sqrt{\frac{F\rho}{L^T}}\right)\left(\alpha - \beta\gamma - \sqrt{\frac{F\rho}{L^T}} - 2(1-\beta)\gamma\right)}{2\eta L^T\left(\alpha - \bar{\beta}^T\gamma - \sqrt{\frac{F\rho}{L^T}}\right)^2} \tag{2.22}$$

and the derivative of G with respect to L_F is

$$\begin{aligned} \frac{\partial G}{\partial L_F} &= \frac{F\rho}{4\eta(L^T)^2\sqrt{\frac{F\rho}{L^T}}\left(\alpha - \bar{\beta}^T\gamma - \sqrt{\frac{F\rho}{L^T}}\right)^2} \\ &\quad \cdot \left[\left(\alpha - \bar{\beta}^T\gamma - 2\sqrt{\frac{F\rho}{L^T}}\right)\left(\alpha - \bar{\beta}^T\gamma - \sqrt{\frac{F\rho}{L^T}}\right)\left(\alpha - \beta\gamma - \sqrt{\frac{F\rho}{L^T}}\right)\right. \\ &\quad + \left(\alpha - \bar{\beta}^T\gamma - 2\sqrt{\frac{F\rho}{L^T}}\right)\left(\alpha - \bar{\beta}^T\gamma - \sqrt{\frac{F\rho}{L^T}}\right)\left(\alpha - \beta\gamma - \sqrt{\frac{F\rho}{L^T}} - 2(1-\beta)\gamma\right) \\ &\quad \left. + \left(\alpha - \bar{\beta}^T + 2\left(\bar{\beta} - \bar{\beta}_F\right)\frac{L\gamma}{L^T}\right)\left(\alpha - \beta\gamma - \sqrt{\frac{F\rho}{L^T}}\right)\left(\alpha - \beta\gamma - \sqrt{\frac{F\rho}{L^T}} - 2(1-\beta)\gamma\right)\right] \end{aligned} \tag{2.23}$$

If $\beta \geq 2 - \frac{\alpha - \sqrt{\frac{\rho F}{L}}}{\gamma}$, then $\beta \geq 2 - \frac{\alpha - \sqrt{\frac{\rho F}{L+L_F}}}{\gamma}$ for all $L_F \geq 0$, which is equivalent to $\alpha - \beta\gamma - \sqrt{\frac{\rho F}{L^T}} - 2(1-\beta)\gamma \geq 0$ and $\frac{\partial G}{\partial \bar{\beta}_F} \leq 0$. If, in addition, $\bar{\beta}_F \leq \bar{\beta}$, then all terms in equation (2.23) are positive and $\frac{\partial G}{\partial L_F} > 0$. Given that the gains from trade are zero for $\bar{\beta}_F = \bar{\beta}$ and $L_F = 0$, they must be strictly positive for all $\bar{\beta}_F \leq \bar{\beta}$ and all $L_F > 0$.

Chapter 3

Endogenous trade policy with heterogeneous firms

3.1 Introduction

There is by now a broad consensus among trade economists as well as political scientists that trade policies are set by politicians who are subject to pressures applied by special interest groups. In fact, lobbying for trade policy is a widely spread phenomenon. Between 1998 and 2008, 84 % of all U. S. sectors at the 4-digit SIC level were engaged in lobbying for trade policy, according to a recent dataset about lobbying expenditures in the U. S. (Bombardini and Trebbi, 2009). The theoretical benchmark in this line of literature is the "Protection for Sale" model of Grossman and Helpman (1994), in which some organized sectors make political contributions to sway the government's trade policy choice in their favor. The incumbent government trades off social welfare against these political contributions, and thus makes a trade policy choice that is biased toward the interest of the lobbying sectors.

Even though the "Protection for Sale" model has found general empirical support,[1] it remains silent on a couple of interesting issues. Firstly, it focuses on a small open economy in which all sectors behave perfectly competitive and thus engage in inter-industry trade only. By construction, it has nothing to say about the trade policy that would emerge in an environment with imperfect competition and intra-industry trade. This is however an important issue, given the prevalence of intra-industry trade in developed economies.[2] Secondly, the model abstracts from the role of individual firms in the

[1] For a critical survey of the empirical evidence on the "Protection for Sale" model, see Imai et al. (2009).

[2] According to Brülhart (2009), the share of intra-industry trade in total trade as measured by the Grubel-Lloyd index has been 0.32 in 2006 for high income countries, with industries being classified at the 5-digit SITC level.

political process. Yet, firms within a sector differ in their political activity, a fact that has been discussed predominantly by political scientists. Larger firms, as measured by sales, make higher contributions to political action committees in the U.S. (Bombardini, 2008; Drope and Hansen, 2006; Sadrieh and Annavarjula, 2005 and others). In the European Union context, they are more likely to have an office in Brussels and to be accredited to lobby the European Parliament (Bernhagen and Mitchell, 2006). Smaller enterprises, in contrast, are more reluctant to engage in the process of trade policy formation due to financial constraints and lack of expertise (Fliess and Busquets, 2006). To the extent that large and small firms differ in their preferences regarding trade policy, a purely sectoral analysis may miss important determinants of the strength and the objective of lobbying activities. Thirdly, like most of the theoretical contributions on the political economy of trade policy, the analysis concentrates on import tariffs and export subsidies as the relevant trade policy instruments. However, during decades of multilateral trade negotiations, tariffs on manufacturing goods have fallen substantially. In 2007, the unweighted average applied tariff rate in high income OECD countries was below 3% (World Bank, 2009). At the same time, non-tariff barriers to trade such as technical barriers or customs procedures and administrative practices have gained importance. The use of technical barriers, for instance, has almost doubled from 1994 to 2004. In this period, the percentage of tariff lines affected by technical barriers has risen from 32% to 59% (UNCTAD, 2005). Recent empirical work by Chen and Novy (2008) suggests that technical barriers to trade have a significantly negative impact on trade integration within the European Union. Explaining around 5% of the variation in bilateral, industry-specific trade frictions, technical barriers are the most important policy-related trade barrier. Together with undue administrative complications, technical barriers are perceived by exporters around the world to be relevant obstacles to foreign market access (OECD, 2005). After all, it has been argued that non-tariff barriers to trade are easier to manipulate unilaterally and therefore more appropriate for a political economy setup (Bombardini, 2008).

The present paper accounts for these facts and modifies the theoretical framework of Grossman and Helpman (1994) to study the endogenous determination of non-tariff barriers in a lobbying model with heterogeneous firms and intra-industry trade between two asymmetric countries. The model is based on Chaney (2008) and similar to the one used for a closed economy in Rebeyrol and Vauday (2009). In each country, there is a given mass of firms producing varieties of a differentiated good with heterogeneous marginal costs. In order to access the market and sell their products, both domestic producers and foreign exporters have to incur some fixed costs. These costs are potentially different for domestic producers and foreign exporters and may be interpreted as the costs of adapting the product to local standards, of testing and certifying the product, of complying with legal requirements, or of passing customs and administrative procedures.

Non-tariff barriers to trade are interpreted as additional regulations which raise these fixed costs of gaining market access. Some regulations affect both foreign exporters and domestic producers. Technical standards or labeling requirements, for example, cannot be imposed on foreign exporters only, since the national treatment principle of the WTO requires that once the imported goods have crossed the border, they must be treated like locally produced goods. Such regulations will be referred to as "behind-the-border measures". They are assumed to leave the ratio of market access costs for foreign exporters to market access costs for domestic producers unaffected. Other regulations, such as customs and administrative procedures, affect foreign exporters only, and thus raise the ratio of market access costs for foreign exporters to market access costs for domestic producers. Such regulations will be referred to as "border measures", since they accrue when the imported goods pass the border.

When a country introduces behind-the-border measures, domestic firms and foreign exporters with high marginal costs cannot generate enough revenues to cover the increased fixed costs of accessing the country's market anymore and exit. This reduces competition, and increases the market shares and profits of those domestic and foreign firms with low marginal costs. In addition to this profit shifting effect within countries, there is also a profit shifting effect across countries. In particular, profits will be shifted away from the country that introduces behind-the-border measures whenever this country has a smaller ratio of very efficient to very inefficient firms than its trading partner. However, even if profits are shifted in the opposite direction, the introduction of behind-the-border measures never increases social welfare in the country, since it reduces the variety available to consumers. Yet, if only the largest and thus the most efficient firms in the country engage in lobbying their government, as the empirical evidence suggests, and if the government is sufficiently susceptible to political influence of domestic special interest groups, it will nevertheless implement behind-the-border measures. The equilibrium level of technical standards or labeling requirements will be the larger, the stronger the profit shifting effect between domestic firms, and the lower the government's concern about the social welfare in its country.

When a country introduces border measures, it drives the least efficient foreign firms out of its market. Domestic firms are shielded from foreign competition, and this induces some domestic firms that have formerly been inactive to start producing and selling their goods. No domestic firm loses, and the aggregate profits of all domestic firms increase. Nevertheless, like behind-the-border measures, border measures reduce consumer surplus, and a government would never introduce such measures if it solely cared about the social welfare in its country. If the largest domestic firms lobby, however, this may be different. If the most efficient domestic firms gain enough from protection, and are willing to exert a strong political influence, the government will implement the highest possible level of border measures. On the contrary, if the lobbying firms gain only little, and the government cares a lot about social welfare, it will never implement any

border measures at all. In contrast to behind-the-border measures, border measures do not provoke any conflict of interest between domestic firms, and intermediate levels of border measures will never obtain.

Although the literature on firm heterogeneity in international trade is growing fast, it has so far paid little attention to the issue of endogenous trade policy. Four recent contributions stand out. Bombardini (2008) extends the traditional Grossman and Helpman (1994) setup by assuming that each sector is composed of several firms which differ in their endowments with a sector specific factor of production. Firms with a larger endowment produce more, sell more and thus have a stronger incentive to lobby for either import tariffs or export subsidies. Yet, trade is still inter-industry, and there are no conflicts of interest within sectors. This is different in Chang and Willmann (2006), who introduce lobbying into a Melitz (2003) type model of intra-industry trade in which firms are heterogeneous in their productivities. The most productive firms operate on the export market and oppose a reciprocal import tariff since it would reduce their profits made abroad, while the least productive ones sell on the domestic market only and favor an import tariff since it would shield their market from foreign competition. Neither Bombardini (2008) nor Chang and Willmann (2006) consider non-tariff barriers to trade as the relevant policy variables. Do and Levchenko (2009) analyze the determination of the fixed costs of producing for the domestic market, which they interpret as the quality of institutions, in a modified median voter model. The political mechanism is thus different from the one considered here. Also, the fixed costs of producing for the export market are exogenous in their model. The work most closely related to the present paper deals with the endogenous determination of an entry tax in a model with heterogeneous firms and product differentiation. Rebeyrol and Vauday (2009) however focus on a closed economy. They argue informally that in a small open economy a tax on the fixed costs for both foreign exporters and domestic firms, which is equivalent to the behind-the-border measures considered here, would shift profits toward foreign firms if these were more productive on average. Further, they argue that if foreign firms were less productive on average, it would be optimal to introduce a positive entry tax even in the absence of lobbying. The formal analysis provided in the present paper qualifies their intuition, for a large as well as for a small open economy. In addition, by analyzing border measures, the present paper in principle allows for differential "entry taxes" for foreign and domestic producers, and it also addresses the question of endogenous lobby formation.

The rest of the paper is organized as follows. Section 3.2 lays out the basic model. Section 3.3 introduces behind-the-border and border barriers as the relevant trade policy instruments and analyzes their effects on individual and aggregate profits and social welfare. Section 3.4 presents the lobbying game and analyzes the equilibrium trade policies. Section 3.5 deals with possible extensions of the model, including endogenous lobby formation, and section 3.6 concludes.

3.2 The model

There are two countries, Home and Foreign. Whenever necessary, variables are indexed by H or F. In both countries there is a continuum of consumers with mass L_H and L_F, respectively, who share identical preferences over a composite numéraire good C_A and a continuum of varieties of a manufacturing good C_M described by a quasilinear utility function of the form

$$U = C_A + \mu \ln C_M \qquad C_M = \left(\int c_i^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}} \tag{3.1}$$

where $\sigma > 1$ is the elasticity of substitution between any two varieties of the differentiated good. The utility function implies that all else equal, the consumer likes to spread consumption of the manufacturing good over as many varieties as possible. The model can easily be extended to more than one manufacturing sector by using an additively separable utility function like Grossman and Helpman (1994). Since this rules out cross-price effects, and since the quasilinear structure of preferences rules out income effects, it would still be an almost partial equilibrium model that could be analyzed sector by sector.

Assuming that the income of each consumer is larger than the expenditures for the manufacturing good, which are constant and equal to μ, the individual demand for any imported or locally produced variety i is

$$c_i = \frac{\mu \, p_i^{-\sigma}}{P^{1-\sigma}} \tag{3.2}$$

where p_i is the consumer price and $P = \left(\int p_i^{1-\sigma} di \right)^{\frac{1}{1-\sigma}}$ is the ideal price index over all consumed varieties. As more varieties become available, the ideal price index decreases, and the demand for any single variety falls.

Each consumer inelastically supplies one unit of labor, which is the only factor of production. The numéraire good is produced under perfectly competitive conditions with constant returns to scale in both countries and is freely traded. One unit of output requires one unit of input, which fixes the wage rate at one. The differentiated good is produced with increasing returns to scale under monopolistically competitive conditions, implying that each variety is produced at most by one firm and no firm produces more than one variety. Firms differ in their marginal costs. A firm i producing variety i for its domestic market incurs marginal costs a_i. Trade in the differentiated good is subject to Iceberg trade costs. In order for one unit to arrive in Foreign, a firm i in Home has to ship $\tau_F > 1$ units of its variety, implying that its marginal costs of producing for the Foreign market are $\tau_F a_i$. The analogous holds for a firm i in Foreign, with $\tau_H - 1 > 0$ denoting the Iceberg trade costs from Foreign to Home. Profit maximization implies

that a firm charges a constant markup $\frac{\sigma}{\sigma-1}$ over its marginal costs. Accordingly, the consumer price for a locally produced variety is $p_i = \frac{\sigma}{\sigma-1} a_i$, while it is $p_i = \frac{\sigma}{\sigma-1} \tau_H a_i$ for an imported variety in Home and $p_i = \frac{\sigma}{\sigma-1} \tau_F a_i$ for an imported variety in Foreign.

If a firm wants to sell its variety in its country of origin, it has to comply with domestic product market regulations such as technical standards, testing and certification procedures, or legal requirements. This creates fixed costs, which are denoted by f_{HD} for a Home firm and by f_{FD} for a Foreign firm. If a firm wants to export its product, it has to comply with the product market regulations in the target country. In addition, it has to pass certain customs and administrative routines at the border. Altogether, exporting creates fixed costs, which are denoted by f_{HE} for a Home firm, and by f_{FE} for a Foreign firm.

Using profit maximizing consumer prices and the corresponding aggregate demands, the profits of a Home firm with marginal costs a_i from selling on its domestic market are

$$\pi_{HD}(a_i) = \frac{\mu}{\sigma} \left(\frac{\sigma}{\sigma - 1} \right)^{1-\sigma} L_H P_H^{\sigma-1} a_i^{1-\sigma} - f_{HD} \tag{3.3}$$

while its profits from exporting are

$$\pi_{HE}(a_i) = \frac{\mu}{\sigma} \left(\frac{\sigma}{\sigma - 1} \right)^{1-\sigma} L_F P_F^{\sigma-1} \left(\tau_F a_i \right)^{1-\sigma} - f_{HE} \tag{3.4}$$

where P_H denotes the ideal price index in Home, and P_F denotes the ideal price index in Foreign. Analogous expressions follow for a Foreign firm. The higher a Home firm's marginal cost, the less it sells on its domestic market. If a firm's marginal costs are too high, the net revenues from being active on the domestic market are too small to cover the associated fixed costs, and the firm will exit. Thus, there is a cutoff level of marginal costs a_{HD}, implicitly defined by $\pi_{HD}(a_{HD}) = 0$, such that only Home firms with $a_i \leq a_{HD}$ are active on their domestic market. Similarly, only Home firms with $a_i \leq a_{HE}$ export their products and make non-negative profits on the Foreign market, where a_{HE} is given by $\pi_{HE}(a_{HE}) = 0$. The corresponding cutoff values for Foreign firms are denoted by a_{FD} and a_{FE}, respectively.

To make the model suitable for a political economy setup, I assume that there is a fixed mass of potential firms M_H in Home and M_F in Foreign.[3] Potential firms in Home draw their marginal costs $a \in (0, \bar{a}_H]$ from the cumulative distribution function

$$H(a) = \left(\frac{a}{\bar{a}_H} \right)^{\kappa} \tag{3.5}$$

[3]The assumption of a fixed mass of potential entrepreneurs has also been used by Chaney (2008), Arkolakis (2008), and Do and Levchenko (2009), amongst others.

while firms in Foreign draw their marginal costs $a \in (0, \bar{a}_F]$ from the cumulative distribution function

$$F(a) = \left(\frac{a}{\bar{a}_F}\right)^{\kappa} \tag{3.6}$$

with $\kappa + 1 - \sigma > 0$, a standard regularity condition. The distribution of marginal costs a is equivalent to a Pareto distribution of marginal productivities $1/a$ with shape parameter κ and scale parameters $\bar{a}_H$ or $\bar{a}_F$, respectively. Using a Pareto distribution for marginal productivities is now quite common in the literature on heterogeneous firms, since it is in line with the empirical evidence on firm sales and ensures analytical tractability.[4] A possible generalization of the marginal cost distributions would be to allow not only for different scale parameters $\bar{a}_H$ and $\bar{a}_F$, but also for different shape parameters κ_H and κ_F. I will comment on this generalization whenever it generates additional insights. For the rest, I will content myself with the assumption of identical shape parameters and model differences in average productivities across countries with different scale parameters. This does not change the conclusions qualitatively, eases exposition, permits closed form solutions and fosters intuition.

With the distributions of marginal costs given in (3.5) and (3.6), I can explicitly solve for the price index in Home as a function of the mass of potential firms in both countries, M_H and M_F, the population size L_H, the size of the fixed costs f_{HD} and f_{FE}, the preference parameter σ and the distribution parameters κ, $\bar{a}_H$, and $\bar{a}_F$. The price index in Foreign follows analogously. This gives closed form solutions for the cutoff values a_{HD}, a_{HE}, a_{FD}, and a_{FE}, and for the individual profits of Home and Foreign firms from selling on their domestic and export market as a function of their marginal cost parameter a. All solutions are given in the appendix. Aggregating individual profits from selling on the Home market over all active Home firms gives

$$\pi_{HD}^{agg} = M_H \int_0^{a_{HD}} \pi_{HD}(a) dH(a) = L_H \frac{\mu}{\kappa} \frac{\sigma - 1}{\sigma} \left(1 + \frac{M_F}{M_H} \left(\frac{f_{FE}}{f_{HD}}\right)^{\frac{\kappa+1-\sigma}{1-\sigma}} \left(\frac{\bar{a}_H}{\tau_H \bar{a}_F}\right)^{\kappa}\right)^{-1} \tag{3.7}$$

while aggregating individual profits from selling on the Foreign market over all exporting Home firms yields

$$\pi_{HE}^{agg} = M_H \int_0^{a_{HE}} \pi_{HE}(a) dH(a) = L_F \frac{\mu}{\kappa} \frac{\sigma - 1}{\sigma} \left(1 + \frac{M_F}{M_H} \left(\frac{f_{FD}}{f_{HE}}\right)^{\frac{\kappa+1-\sigma}{1-\sigma}} \left(\frac{\tau_F \bar{a}_H}{\bar{a}_F}\right)^{\kappa}\right)^{-1} \tag{3.8}$$

Exchanging H and F in equations (3.7) and (3.8) gives the corresponding expressions for the aggregate profits of Foreign firms. As it turns out, Pareto distributions with

[4] Examples for papers that use a Pareto distribution for marginal productivities include Chaney (2008), Arkolakis (2008), Baldwin and Forslid (2010), Ghironi and Melitz (2005), and Helpman et al. (2004). For the empirical evidence, see Axtell (2001) and Corcos et al. (2007).

identical shape parameters have the convenient feature that the sum of aggregate profits of both Home and Foreign firms from selling on a specific market, e. g. the Home market, is constant. In particular, it is independent of the fixed costs of gaining access to this market,

$$\pi_{HD}^{agg} + \pi_{FE}^{agg} = L_H \frac{\mu}{\kappa} \frac{\sigma - 1}{\sigma} \tag{3.9}$$

$$\pi_{FD}^{agg} + \pi_{HE}^{agg} = L_F \frac{\mu}{\kappa} \frac{\sigma - 1}{\sigma}. \tag{3.10}$$

I assume that firms do not have sources of income other than profits, and that they spend all of their profits on the numéraire good. This ensures that their interest in lobbying solely comes from their role as producers and not from their role as consumers. Thus, they do not care about prices in sectors other than their own. A comparable assumption to simplify the traditional Grossman and Helpman (1994) setup has been advocated by Bombardini (2008) and Baldwin and Robert-Nicoud (2007), for instance. Social welfare in the Home country is then given by the sum of the aggregate profits of Home firms from selling on their domestic market and from exporting, aggregate labor income, and total consumer surplus,

$$W = \pi_{HD}^{agg} + \pi_{HE}^{agg} + L_H + L_H \left(\mu \ln \frac{\mu}{P_H} - \mu \right). \tag{3.11}$$

3.3 Trade policy instruments

The government in Home may implement two different types of non-tariff barriers to trade, namely behind-the-border measures, such as technical barriers to trade, and border measures, such as customs procedures. In this section, I will analyze the effects of these two different measures on individual and aggregate profits of Home firms and consumer welfare to point out the heterogeneity of preferences over these two trade policy variables, and to identify the social welfare maximizing choice. How the level of protection is ultimately determined in the lobbying game will be the subject of section 3.4.

3.3.1 Behind-the-border measures

Behind-the-border measures are understood as regulations which increase the fixed costs for both Home and Foreign firms of accessing the Home market, f_{HD} and f_{FE}, by a factor $\alpha \in (1, \bar{\alpha}]$.[5] Such regulations have an anti-competitive effect in that they force the least

[5]The assumption of multiplicative behind-the-border measures is mainly made for reasons of analytical tractability. If accessing the Home market is more difficult for Foreign exporters than for Home

efficient Home producers and Foreign exporters to withdraw from the Home market. Their marginal costs are too high and hence their sales too low to cover the increased fixed costs. The more comprehensive these additional regulations, the more firms have to exit. The benchmark case in which $\alpha = 1$ characterizes a situation in which the Home government does not implement any undue regulations at all.

Lemma 3.1 *Behind-the-border measures force the least efficient Home and Foreign firms that have been active on the Home market to exit,* $\frac{\partial a_{HD}(\alpha)}{\partial \alpha} < 0$ *and* $\frac{\partial a_{FE}(\alpha)}{\partial \alpha} < 0$ *for all* $\alpha \geq 1$.

This follows from multiplying the fixed costs f_{HD} and f_{FE} in the cutoff values a_{HD} and a_{FE} with α and taking the respective derivatives. As the least efficient firms exit the Home market, the available product variety shrinks and the price index in Home increases, $\frac{\partial P_H(\alpha)}{\partial \alpha} > 0$. Equation (3.3) for Home firms and the analog of equation (3.4) for Foreign firms show that this increase in the price index P_H benefits the remaining firms the more the smaller their marginal costs. For the most efficient Home and Foreign firms, the gain in market share due to reduced competition more than compensates the increase in fixed costs, and their profits rise at the expense of the profits of the least efficient Home and Foreign firms. This profit shifting effect is illustrated in figure 3.1 for Home firms, with a similar picture applying to Foreign firms.

Thus, behind-the-border measures shift profits from the least efficient Home firms to the most efficient Home firms, and from the least efficient Foreign exporters to the most efficient Foreign exporters. From a social welfare perspective, we might also be interested in whether such measures also shift profits across borders, that is from Foreign exporters to Home firms. This is however not the case, at least if both countries are characterized by cost distributions with identical shape parameters. Inspection of equation (3.7) reveals that with identical shape parameters, any behind-the-border measures which increase the fixed costs f_{HD} and f_{FE} by the same factor cancel out and thus have no impact on the sum of all profits made by Home firms. The social welfare maximizing policy simply is to implement no behind-the-border measures at all, since any other policy would just raise the price index, and hence reduce consumer surplus. Thus, the assumption of identical shape parameters allows me to abstract from technical barriers to trade which are introduced by the Home government for any reason other than giving in to the pressure of lobbying groups. Moreover, it has the interesting implication that if the differentiated

firms, $f_{FE} > f_{HD}$, which is quite plausible due to informational disadvantages, cultural differences, or language barriers, this assumption implies that the absolute costs of complying with a new technical standard are higher for Foreign exporters. Hence, in absolute terms, behind-the-border measures have a discriminatory effect against Foreign firms, and in this respect may be seen as a protectionist trade policy. An alternative way would be to model behind-the-border measures as regulations which impose the same absolute cost on both Foreign exporters and Home firms. Additive behind-the-border measures would generally create the same conflict of interest between large and small firms. However, if $f_{FE} > f_{HD}$, they would unintentionally increase the relative competitiveness of Foreign exporters and thus would hurt rather than protect Home firms.

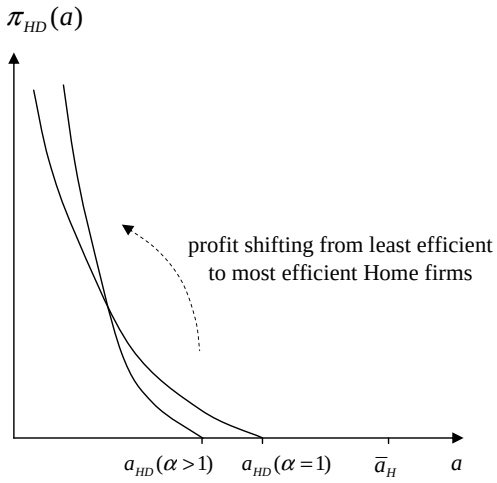

Figure 3.1: Effect of behind-the-border measures on the profits of Home firms

good sector analyzed here was considered as an entity as in the original Grossman and Helpman (1994) model, it would have no interest whatsoever in lobbying for non-tariff barriers to trade like technical standards. The incentive to lobby arises only on the firm level, and any bias in the equilibrium trade policy will solely be driven by heterogeneous lobbying activities of large and small firms.

However, for completeness, and since it is an interesting result that relates well to the literature, I will briefly discuss how behind-the-border measures shift profits across countries characterized by cost distributions with different shape parameters κ_H and κ_F.

Proposition 3.1 *Behind-the-border measures shift aggregate profits from selling on the Home market from Foreign to Home firms if and only if the distribution of firms is more skewed in Foreign than in Home, that is* $\frac{\partial \pi_{HD}^{agg}(\alpha)}{\partial \alpha} > 0$ *and* $\frac{\partial \pi_{FE}^{agg}(\alpha)}{\partial \alpha} < 0$ *if and only if* $\kappa_H < \kappa_F$.

For a proof, see the appendix. Interestingly, whether profits from selling on the Home market are shifted from Foreign to Home firms depends only on the shape parameters κ_H and κ_F, and not on the scale parameters $\bar{a}_H$ and $\bar{a}_F$. This is because the scale parameters $\bar{a}_H$ and $\bar{a}_F$ affect the relevant cutoff values in Home and Foreign in the same way, and thus lead to the same ratio of winners to losers in Home and Foreign. However, different shape parameters κ_H and κ_F give winners and losers a different weight. If $\kappa_H < \kappa_F$, then the ratio of very efficient firms to rather inefficient firms and hence the ratio of winners to losers from behind-the-border measures is higher in Home than in Foreign, implying that in the aggregate, profits are shifted from Foreign to Home firms.

An interesting implication of this result is that the average of marginal costs of Home and Foreign firms, given by $\int_0^{\bar{a}_H} a \, dH(a) = \frac{\kappa_H}{\kappa_H+1}\bar{a}_H$ and $\int_0^{\bar{a}_F} a \, dF(a) = \frac{\kappa_F}{\kappa_F+1}\bar{a}_F$, respectively,

cannot predict the direction of the profit shifting effect of behind-the-border measures. It is quite possible that potential Foreign firms have lower marginal costs and hence are more productive on average because $\bar{a}_F$ is comparably small, but profits are nevertheless shifted toward Home firms.[6] This qualifies the result of Rebeyrol and Vauday (2009) who argue by means of a rather restrictive example that behind-the-border measures would shift profits to Home firms only if these were more productive on average.[7]

Moreover, Rebeyrol and Vauday (2009) argue that if an entry tax would shift profits to Home firms, it could be optimal to introduce a positive entry tax even in the absence of lobbying. This is true because an entry tax, contrary to the behind-the-border measures considered here, generates tax revenues. In the absence of such revenues, however, the implementation of purely anti-competitive regulations like behind-the-border measures can never be social welfare maximizing.

Proposition 3.2 *For any values of κ_H and κ_F, the introduction of behind-the-border measures reduces social welfare in Home, $\frac{\partial W(\alpha)}{\partial \alpha} < 0$ for all $\alpha \geq 1$.*

See the appendix for a proof, which shows that the potentially positive effect of behind-the-border measures on the aggregate profits of Home firms is always dominated by their negative effect on consumer surplus.

3.3.2 Border measures

Border measures are regulations set by the Home government which increase the fixed costs f_{FE} for Foreign exporters by a factor $\beta \in (1, \bar{\beta}]$. To give an example, the government may increase the number of documents required to obtain an import license or it may extend the time needed to pass the authorization process at the border. Anecdotal evidence of such measures, which clearly discriminate against foreign exporters and which are largely unrelated to the quantity shipped, abounds.[8] And recent empirical

[6] This argument also holds if the average of marginal costs is conditioned on being active on the Home market. In other words, even if active Foreign exporters are more productive on average,

$$\int_0^{a_{HD}} a\, dH(a) = \frac{\kappa_H}{\kappa_H + 1} f_{HD}^{\frac{1}{1-\sigma}} > \frac{\kappa_F}{\kappa_F + 1} f_{FE}^{\frac{1}{1-\sigma}} \tau_H^{-1} = \int_0^{a_{FE}} a\, dF(a),$$

because f_{HD} is small compared to f_{FE}, it is still possible that behind-the-border measures shift aggregate profits from selling to the Home market from Foreign to Home firms.

[7] Their argument is actually made for Home being a small open economy. Yet, it carries over to Home being a large open economy, since the only difference is whether Home firms have an impact on the Foreign price index or not. The Foreign price index is however irrelevant for the profit shifting effects of behind-the-border measures. For a model of a small open economy involved in intra-industry trade, see Demidova and Rodríguez-Clare (2009).

[8] The European Commission's Market Access Database, for instance, lists not only undue customs procedures but also technical barriers to trade which impede European exports to third countries.

work suggests that they may indeed have economically and statistically significant negative effects on trade flows. In a gravity equation, Wilson (2007) estimates the elasticity of exports with respect to the number of documents and signatures required by the importer, and with respect to the days the goods need to cross the border. His estimates are -0.41, -0.88 and -0.96, respectively, indicating that a 10% increase in the number of documents required would entail a 4% reduction of trade flows, for instance.

What is the effect of border measures in the present model? They shield domestic producers from Foreign competition, since small Foreign exporters are not able to cover the increased fixed costs any more and hence stop selling their varieties on the Home market. This induces Home firms that have formerly been inactive to start producing for the Home market. Again, $\beta = 1$ characterizes the benchmark situation without any undue border measures.

Lemma 3.2 *Border measures force the least efficient Foreign exporters to withdraw from the Home market and induce less efficient Home firms to start producing for the Home market,* $\frac{\partial a_{FE}(\beta)}{\partial \beta} < 0$ *and* $\frac{\partial a_{HD}(\beta)}{\partial \beta} > 0$ *for all* $\beta \geq 1$.

This follows from multiplying the fixed costs f_{FE} in the cutoff values a_{FE} and a_{HD} with β and taking the respective derivatives. As the positive effect of border measures on the mass of active Home firms is only secondary, the overall product variety available in Home decreases and hence the price index in Home increases, $\frac{\partial P_H(\beta)}{\partial \beta} > 0$. As before, the anti-competitive effect of border measures benefits the most efficient Foreign exporters. Their gain in market share overcompensates the rise in fixed costs, and their profits increase at the expense of the profits of the small Foreign exporters. In Home, all firms gain, and they gain the more the smaller their marginal costs, as illustrated in figure 3.2. Contrary to the case of behind-the-border measures, border measures do not provoke any conflict of interest among Home firms. However, since large firms gain more, their willingness to make campaign contributions in order to bring the government to implement a certain trade policy $\beta > 1$ is larger, and hence their political influence is stronger.

Inspection of equations (3.7) and (3.9) confirms that the aggregate profits of Home firms from selling on the domestic market rise, at the expense of the aggregate profits of Foreign exporters. However, even if border measures unambiguously raise aggregate profits of Home firms, their impact on social welfare is negative.

Proposition 3.3 *For any values of* κ_H *and* κ_F*, the introduction of border measures reduces social welfare in Home,* $\frac{\partial W(\beta)}{\partial \beta} < 0$ *for all* $\beta \geq 1$.

See the appendix for a proof. Intuitively, as the decline in the mass of varieties imported from Foreign is only partially offset by the increase in the mass of varieties produced at Home, consumers are worse off, and their loss in utility outweighs the gain in aggregate

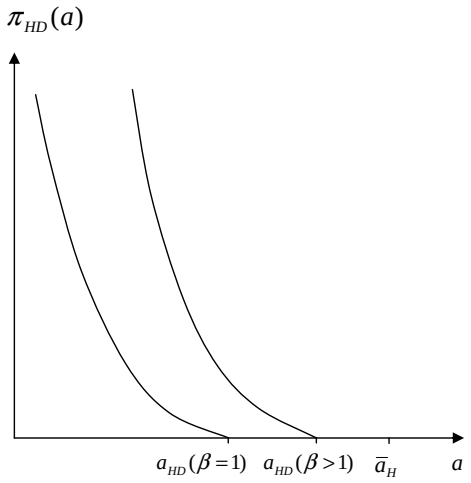

Figure 3.2: Effect of border measures on the profits of Home firms

profits. Thus, the social welfare maximizing policy is to introduce no border measures at all. Again, any bias toward protectionist measures can only be due to the lobbying activities of some Home firms.

3.4 Lobbying

In principle, the theoretical framework is appropriate to model lobbying on both trade policy instruments jointly. However, allowing behind-the-border measures and border measures to be determined simultaneously does not add much insight, and blurs the main intuition. Therefore, I will consider lobbying on only one trade policy at a time, and I will start and introduce the political game with behind-the-border measures.

3.4.1 Theoretical framework

Like Grossman and Helpman (1994), I model the lobbying process as a menu auction based on the theoretical framework of Bernheim and Whinston (1986). I assume that Home firms are organized exogenously into $j \in K$ lobbies. At this point, I will make no specific assumption on the composition of the lobbies. Each lobby acts as a bidder and makes a menu of offers to the Home government, one for each level of behind-the-border measures that the Home government may choose. Put differently, each lobby announces political contributions $C_j(\alpha)$ contingent on the level of behind-the-border measures $\alpha \in [1, \bar{\alpha}]$ that the Home government implements. The objective of each lobby is to maximize the joint welfare of its members net of contributions,

$$G_j(\alpha) = W_j(\alpha) - C_j(\alpha) = \pi^j_{HD}(\alpha) + \pi^j_{HE} - C_j(\alpha). \tag{3.12}$$

The Home government acts as an auctioneer. It takes the bids of the lobbies as given, and chooses behind-the-border measures $\alpha \in [1, \bar{\alpha}]$ to maximize a weighted sum of social welfare in Home and the lobbies' political contributions,

$$G(\alpha) = \phi W(\alpha) + \sum_{j \in K} C_j(\alpha) \tag{3.13}$$

The higher ϕ, the more the Home government cares about social welfare and the less it is susceptible to the pressure of lobbying firms.

3.4.2 Timing

The timing of the lobbying game is as follows. First, Home and Foreign firms draw their marginal costs a from the distributions $H(a)$ and $F(a)$, respectively. Second, Home firms organize exogenously into lobbies. Third, each lobby $j \in K$ offers a contribution for each possible level of α, $C_j(\alpha)$, to maximize its welfare net of contributions, $G_j(\alpha)$. The Home government takes the contribution schedules as given and chooses $\alpha \in [1, \bar{\alpha}]$ to maximize $G(\alpha)$. It implements the chosen trade policy and receives the corresponding contributions. Then all Home and Foreign firms produce for all markets on which they can make non-negative profits, and withdraw from markets on which they would make losses given the actual level of behind-the-border measures.

3.4.3 Equilibrium

Bernheim and Whinston (1986) show that the equilibrium of the lobbying game, if set up as a menu auction, can be characterized as follows:

Proposition 3.4 *(Bernheim and Whinston, 1986)* $\left\{C^o_j(\alpha)_{j \in K}, \alpha^o\right\}$ *is a subgame-perfect Nash equilibrium of the lobbying game if and only if*

(a) $C^o_j(\alpha)$ *is feasible for all* $j \in L$

(b) α^o *maximizes* $\phi W(\alpha) + \sum_{j \in K} C^o_j(\alpha)$ *on* $[1, \bar{\alpha}]$

(c) α^o *maximizes* $\phi W(\alpha) + \sum_{j \in K} C^o_j(\alpha) + W_j(\alpha) - C^o_j(\alpha)$ *on* $[1, \bar{\alpha}]$ *for every* $j \in K$.

(d) for every $j \in K$ *there exists an* $\alpha^j \in [1, \bar{\alpha}]$ *that maximizes* $\phi W(\alpha) + \sum_{i \in K} C^o_i(\alpha)$ *on* $[1, \bar{\alpha}]$ *such that* $C^o_j(\alpha^j) = 0$

Condition (a) implies that each lobby's contribution schedule must not be negative, nor larger than the total income of the lobby's members. Condition (b) captures the fact

that the Home government implements the trade policy $\alpha \in [1, \bar{\alpha}]$ that maximizes its own welfare, which is a weighted sum of the social welfare in Home and the political contributions. Condition (c) ensures that the equilibrium trade policy α^o maximizes the joint surplus of the government and any lobby j. If this were not the case, lobby j could modify its contribution schedule to increase the joint surplus and keep a fraction of the additional gain. And finally, condition (d) states that each lobby j contributes just enough to make the government indifferent between the equilibrium policy α^o and the policy it would choose if lobby j did not participate in the lobbying game.

A common problem of lobbying games is the multiplicity of equilibrium contribution schedules. However, Bernheim and Whinston (1986) show that the set of a lobby's best responses to any combination of contribution schedules offered by all other lobbies always includes a truthful contribution schedule. Such a schedule reflects the true preferences of the lobby in every point $\alpha \in [1, \bar{\alpha}]$ and stipulates a payment to the government which equals the excess welfare of the lobby at α relative to some basic level B_j. Formally, a truthful contribution schedule of lobby j is given by

$$C_j^T(\alpha, B_j) = \max[0, W_j(\alpha) - B_j]. \tag{3.14}$$

It is differentiable everywhere, except where it becomes nil, as long as the lobby's total profits are differentiable. Further, Bernheim and Whinston (1986) show that all truthful Nash equilibria, that is all equilibria which are supported by truthful contribution schedules, and only these equilibria, are coalition-proof, which makes them focal among the set of all Nash equilibria. Truthful Nash equilibria have the compelling property that the equilibrium policy α^o satisfies

$$\alpha^o = \arg\max_{\alpha \in [1,\bar{\alpha}]} \left[\phi W(\alpha) + \sum_{j \in K} W_j(\alpha) \right]. \tag{3.15}$$

Effectively, the Home government maximizes a social welfare function in which organized Home firms are weighted with $1 + \phi$, while non-organized firms and consumers are only weighted with ϕ. Given their useful properties, I will concentrate on truthful Nash equilibria in the following. Note, however, that the necessary condition for an equilibrium policy in the interior of $[1, \bar{\alpha}]$,

$$\phi \frac{\partial W(\alpha^o)}{\partial \alpha} + \sum_{j \in K} \frac{\partial W_j(\alpha^o)}{\partial \alpha} = 0, \tag{3.16}$$

applies even if contributions schedules are not globally truthful, as long as they are differentiable around the equilibrium point α^o. This follows from combining equilibrium conditions (b) and (c).

3.4.3.1 Behind-the-border measures

In line with the empirical evidence, I assume that only the largest, hence the most efficient firms will engage jointly in lobbying for behind-the-border measures. This seems plausible, as they have an aligned interest in behind-the-border measures, and gain most from their introduction. In addition, even though I do not explicitly model this here, forming a lobby may involve fixed costs as in Bombardini (2008), and only firms with low marginal costs and high profits may be able to bear these costs.

Assumption 3.1 *In the differentiated goods sector, all Home firms with $a \in (0, a_L]$ are organized into a single lobby L, with $a_L < a_{HD}(\alpha{=}1, \beta{=}1)$. All Home firms with $a > a_L$ do not engage in lobbying.*

Thus, I assume that there is only one lobby, and that its composition is given exogenously. I will rationalize this assumption and discuss the possibility of endogenizing the lobby formation process in section 3.5.3. The lobby's welfare is the joint welfare of its members and given by $W_L(\alpha) = \pi^L_{HD}(\alpha) + \pi^L_{HE}$. The lobby's profits from exporting are independent of α, while the lobby's profits from selling on the domestic market are given by

$$\pi^L_{HD}(\alpha) = \begin{cases} M_H \left(\frac{a_L}{\bar{a}_H}\right)^{\kappa} \left(\frac{\mu}{\sigma} \left(\frac{\sigma}{\sigma-1} \right)^{1-\sigma} P_H(\alpha)^{\sigma-1} L_H a_L^{1-\sigma} \frac{\kappa}{\kappa+1-\sigma} - \alpha f_{HD} \right) & \text{if } \alpha < \alpha_L \\ \pi^{agg}_{HD} & \text{if } \alpha \geq \alpha_L \end{cases} \tag{3.17}$$

For all $\alpha < \alpha_L$, the lobby's profits from selling on the Home market are increasing and concave in α. As α increases, however, the cutoff value $a_{HD}(\alpha)$ declines. At α_L, the cutoff value coincides with the marginal costs of the least efficient lobby member, $a_{HD}(\alpha_L) = a_L$, and the lobby consist of all Home firms which are active on the domestic market. Consequently, for all $\alpha \geq \alpha_L$, the lobby's profits coincide with the aggregate profits of Home firms from selling on the domestic market. Since the gains of the largest firms in the lobby exactly offset the losses of the smallest members of the lobby, the lobby's total profits do not depend on α anymore.

With only the largest firms participating in the lobbying game, the following result regarding the equilibrium level of behind-the-border measures holds:

Proposition 3.5 *Suppose that assumption 3.1 is satisfied and contribution schedules are truthful. Further, suppose that $\phi \frac{\partial W(\alpha)}{\partial \alpha} + \frac{\partial \pi^L_{HD}(\alpha)}{\partial \alpha} > 0$ at $\alpha = 1$ and that $\alpha_L < \bar{\alpha}$. Then there exists a unique equilibrium level of behind-the-border measures α^o in the interior of $[1, \bar{\alpha}]$ which is characterized by $\phi \frac{\partial W(\alpha^o)}{\partial \alpha} + \frac{\partial \pi^L_{HD}(\alpha^o)}{\partial \alpha} = 0$.*

For a proof, see the appendix. If $\phi \frac{\partial W(\alpha)}{\partial \alpha} + \frac{\partial \pi^L_{HD}(\alpha)}{\partial \alpha} > 0$ at $\alpha = 1$, the lobby's marginal gain in profits and hence the Home governments marginal gain in political contributions

is higher than the weighted marginal loss in social welfare from introducing behind-the-border measures, and the Home government has an incentive to deviate from the socially optimal policy. This is always the case if the price index in Home is sufficiently high, since Foreign firms are rather inefficient or variable trade costs are high, for instance, or if the weight on social welfare ϕ is sufficiently low. As α increases, however, the marginal gain in political contributions declines, and at some point becomes smaller than the weighted marginal loss in social welfare. This point characterizes the unique interior equilibrium level of behind-the-border measures.

Using the derivative of social welfare (3.11) and of the lobby's profits (3.17) with respect to α, and taking into account that the elasticity of the price index with respect to α, $\epsilon_{P_H,\alpha}$, is equal to $\frac{\kappa+1-\sigma}{(\sigma-1)\kappa}$, the first order condition $\phi\frac{\partial W(\alpha^o)}{\partial\alpha}+\frac{\partial\pi^L_{HD}(\alpha^o)}{\partial\alpha}=0$ can be rewritten as

$$-\phi\mu\frac{L_H}{\alpha^o}\frac{\kappa+1-\sigma}{(\sigma-1)\kappa}+M_H\left(\frac{a_L}{\bar{a}_H}\right)^{\kappa}\left(\frac{\mu}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}P_H(\alpha^o)^{\sigma-1}\frac{L_H}{\alpha^o}a_L^{1-\sigma}-f_{HD}\right)=0. \quad (3.18)$$

Applying the implicit function theorem and using the first and second order condition for an interior maximum gives the following comparative static result:

Proposition 3.6 *The equilibrium level of behind-the-border measures which results from the lobbying game in Home, α^o, is increasing in the fixed costs of gaining access to the Home market for Foreign firms, f_{FE}, the variable trade costs from Foreign to Home, τ_H, and the scale parameter of the distribution of marginal costs in Foreign, $\bar{a}_F$. It is decreasing in the mass of Foreign firms, M_F, and in the weight the Home government puts on social welfare, ϕ.*

The larger the parameters f_{FE}, τ_H and $\bar{a}_F$ and the smaller the parameter M_F, the fewer Foreign firms are active on the Home market, and the higher is the ideal price index in Home. A higher ideal price index in Home implies that the marginal gains of the most efficient Home firms from the introduction of behind-the-border measures are larger, and hence their willingness to make political contributions that convince the government to implement such measures is higher. Not surprisingly, the weight the Home government puts on social welfare has a negative impact on the equilibrium level of behind-the-border measures. All other model parameters have an ambiguous effect on the equilibrium level of behind-the-border measures, as they have an impact on both the marginal gain in political contributions and the weighted marginal loss in social welfare.

How about the equilibrium level of political contributions? With truthful contribution schedules $C_L^T(\alpha, B_L)$, the only thing that is left to be determined is the basic level of welfare B_L. In principle, B_L indicates how the surplus of the lobby's political relationship with the Home government is shared. The lobby wishes to make B_L as large as possible and hence contributions as small as possible. However, as Grossman and Helpman

(1994) show, if the lobby raised B_L beyond a certain point, the Home government would neglect the lobby's interest and contributions entirely and, since there are no other lobbies participating in the lobbying game, implement the socially optimal policy. Hence, the lobby will make contributions just large enough and set B_L just small enough to make the Home government indifferent between the socially optimal policy $\alpha = 1$ and the equilibrium policy α^o. That is,

$$\phi W(\alpha^o) + C_L^T(\alpha^o, B_L) = \phi W(\alpha = 1). \tag{3.19}$$

If there is only one active lobby, it captures all of the surplus, and merely compensates the Home government for the weighted loss in social welfare that arises if α^o is implemented, $C_L^T(\alpha^o, B_L) = \phi W(\alpha = 1) - \phi W(\alpha^o)$. Given that the aggregate profits of Home firms from selling on the domestic and the export market remain unaffected by changes in α, the loss in social welfare is equivalent to the loss in consumer surplus that arises from an increase in the price index, $C_L^T(\alpha^o, B_L) = \phi W(\alpha = 1) - \phi W(\alpha^o) = \phi L_H \mu \ln \frac{P_H(\alpha^o)}{P_H(\alpha=1)} = \phi \mu L_H \frac{\kappa+1-\sigma}{(\sigma-1)\kappa} \ln \alpha^o$.

3.4.3.2 Border measures

The same theoretical framework applies if firms lobby for border measures instead. The only difference is that the variable of interest is now $\beta \in \left[1, \bar{\beta}\right]$ instead of $\alpha \in [1, \bar{\alpha}]$. Correspondingly, the subgame-perfect Nash equilibrium of the lobbying game is denoted $\left\{C_j^o(\beta)_{j \in K}, \beta^o\right\}$. As before, the welfare of a lobby which is composed of the most efficient firms is given by $W_L(\beta) = \pi_{HD}^L(\beta) + \pi_{HE}^L$. Like in the case of behind-the-border measures, the lobby's profits from exporting are independent of β, while its profits from selling on the domestic market, which are

$$\pi_{HD}^L(\beta) = M_H \left(\frac{a_L}{\bar{a}_H}\right)^{\kappa} \left(\frac{\mu}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} P_H(\beta)^{\sigma-1} L_H a_L^{1-\sigma} \frac{\kappa}{\kappa+1-\sigma} - f_{HD}\right) \tag{3.20}$$

for all $\beta \geq 1$, depend positively on β via the price index $P_H(\beta)$. Unlike in the case of behind-the-border measures, however, the lobby's marginal gain in profits and hence the marginal gain in political contributions does not decline as β increases. In fact, the larger β, the larger the lobby's marginal gain in profits, and the smaller the marginal loss in social welfare. Therefore, the unique equilibrium policy β^o is never in the interior of $\left[1, \bar{\beta}\right]$. The Home government either chooses the highest possible level of border measures, $\beta^o = \bar{\beta}$, or it implements no border measures at all, $\beta^o = 1$, depending on the size of the lobby and the weight on social welfare.

Proposition 3.7 *Suppose that assumption 3.1 is satisfied and contribution schedules are truthful. Further, suppose that either* $\phi\frac{\partial W(\beta)}{\partial\beta}+\frac{\partial\pi^L_{HD}(\beta)}{\partial\beta}>0$ *at* $\beta=1$ *or* $\phi\frac{\partial W(\beta)}{\partial\beta}+\frac{\partial\pi^L_{HD}(\beta)}{\partial\beta}<0$ *at* $\beta=\bar{\beta}$*. Then there exists a unique equilibrium level of border measures* β^o*. If* $\phi\frac{\partial W(\beta)}{\partial\beta}+\frac{\partial\pi^L_{HD}(\beta)}{\partial\beta}>0$ *at* $\beta=1$*, the Home government implements the highest possible level of border measures,* $\beta^o=\bar{\beta}$*. If* $\phi\frac{\partial W(\beta)}{\partial\beta}+\frac{\partial\pi^L_{HD}(\beta)}{\partial\beta}<0$ *at* $\beta=\bar{\beta}$*, the Home government implements no border measures at all,* $\beta^o=1$*.*

For a proof, see the appendix. If neither of these conditions is satisfied, the equilibrium policy will be either $\beta^o=\bar{\beta}$ or $\beta^o=1$, depending on which policy makes the Home government better off. The condition that $\phi\frac{\partial W(\beta)}{\partial\beta}+\frac{\partial\pi^L_{HD}(\beta)}{\partial\beta}>0$ at $\beta=1$ is satisfied if the lobby is rather large, that is if a_L is high, and if the weight on social welfare is rather small, that is if ϕ is low. In this case, the lobby's marginal gain from regulations that deter Foreign firms from entering the Home market is very high, and hence the government's marginal gain in contributions is very high, while the weighted marginal loss in social welfare is rather low. Since the marginal gain in contributions is increasing in β, while the weighted marginal loss in social welfare is decreasing in β, the Home government benefits from setting β as high as possible. On the contrary, the condition that $\phi\frac{\partial W(\beta)}{\partial\beta}+\frac{\partial\pi^L_{HD}(\beta)}{\partial\beta}<0$ at $\beta=\bar{\beta}$ is likely to hold if the lobby is rather small and the weight on social welfare is comparatively high. In this case, the marginal gain in contributions never exceeds the weighted marginal loss in social welfare in the interval $[1,\bar{\beta}]$, and the Home government has no incentive at all to complicate customs or administrative procedures.[9]

In a truthful equilibrium, the political contributions of the lobby will again reflect the loss that the government suffers from implementing any policy other than the social welfare maximizing policy. Hence, if $\beta^o=\bar{\beta}$, $C^T_L(\beta^o,B_L)=\phi W(\beta=1)-\phi W(\bar{\beta})$, while if $\beta^o=1$, the lobby will make no political contributions at all.

3.5 Extensions

The basic model as well as the lobbying game lend themselves to several extensions, including social welfare enhancing behind-the-border measures, interactions between national governments, and endogenous lobby formation. I will discuss each of these possibilities in the following.

[9]Proposition 3.7 obtains even if the firms represented by the lobby consume the manufacturing good, as long as it is ensured that they all make sufficient profits to cover the associated expenditures μ. Intuitively, if the firms in the lobby consume the manufacturing good, their marginal gain in profits is counteracted by their marginal loss in consumer welfare. Adding this marginal loss on part of the lobby is however equivalent to increasing the relative weight of consumer welfare in the Home government's objective function. The marginal loss in social welfare would then be higher, but still decreasing, while the marginal gain in profits would still be increasing in β, and the equilibrium level of border measures would again be either $\beta^o=\bar{\beta}$ or $\beta^o=1$.

3.5.1 Welfare enhancing measures

Contrary to what I assumed so far, some behind-the-border regulations may have a beneficial effect on consumer welfare, such as food safety requirements or environmental standards. In fact, recognizing this potentially positive effect, the WTO explicitly allows for measures that serve to protect human, animal or plant life and health, but may not put foreign exporters at a disadvantage in comparison to domestic producers, in article 20 of the General Agreement of Tariffs and Trade and tries to distinguish them from hidden protectionist measures in its Agreements on Sanitary and Phytosanitary Measures and on Technical Barriers to Trade.

Allowing for such positive effects of behind-the-border measures to compensate for the loss in welfare due to higher prices does not alter the preceding analysis that much, however. The only difference is that even in the absence of lobbying, it may be beneficial to introduce behind-the-border measures, depending on whether the positive effect on consumer health, for instance, outweighs the negative effect on prices. With lobbying, a beneficial effect of technical standards and regulations simply shifts the equilibrium policy upwards, possibly pushing it to the highest feasible level of behind-the-border measures, $\bar{\alpha}$.

3.5.2 Interactions between national governments

The preceding analysis focuses on unilateral trade policies which are implemented by the national government of one country in response to the pressure applied by a domestic interest group. However, there is reason to believe that a national government cannot determine its trade policy in isolation. Rather, it may provoke retaliatory sanctions by the other country, possibly triggering a trade war, or it may enter into trade negotiations, eventually ending up in a multilateral agreement on non-tariff barriers to trade. The issue of interaction between national governments, either noncooperative as in the case of trade wars, or cooperative, as in the case of trade negotiations, has been addressed in the traditional Grossman and Helpman (1994) framework by Bagwell and Staiger (1999) and Grossman and Helpman (1995), for instance.

What are the implications of such interactions at the international level for the equilibrium trade policy outcomes in the present model? Formally, they add another stage to the game, which occurs after the lobbies in Home and Foreign have announced their contribution schedules to their national governments. In this stage, with the contribution schedules of their domestic lobbies in mind, the Home and the Foreign government either set their trade policies simultaneously and noncooperatively, or they bargain over the levels of border or behind-the-border measures to be implemented in Home and Foreign.

Interestingly, when the Home and the Foreign government set their levels of border measures simultaneously and noncooperatively, the equilibrium trade policy in Home will

be exactly the same as the one described in the previous section. This is because the markets in Home and Foreign are separated, and the profits from selling to the domestic market and from exporting are independent of each other. No matter which trade policy is chosen by the Foreign country, the level of border measures that maximizes the Home government's objective function is the same as in a situation without international interactions. The Home government's best response is independent of the Foreign government's trade policy choice, and vice versa. Hence, the Home government cannot credibly commit to retaliatory sanctions in case the Foreign country imposes restrictive border measures. If $\beta = 1$ maximizes the Home government's welfare function if the Foreign government chooses to implement no border measures at all, it also maximizes the Home government's welfare function if the Foreign government chooses to implement the highest possible level of border measures. The same argument is true for behind-the-border measures. Thus, the analysis in the preceding section is robust to noncooperative interaction between the Home and the Foreign government.

Yet, when the levels of border measures to be implemented in Home and Foreign are determined cooperatively in a bargaining situation, they are most likely different from the levels that would obtain in a situation without international interactions. Grossman and Helpman (1995) point out that if both the Home and the Foreign government enter into trade negotiations with the aim of maximizing their respective objective function, the Nash bargaining solution implies that the equilibrium level of border measures in Home, β^o and in Foreign, β_F^o must be efficient in the sense that they maximize the weighted sum $\bar{G} = \phi^F G + \phi G^F$, where G^F is the objective function of the Foreign government and ϕ^F is the weight the Foreign government puts on the social welfare in its country. Assuming that only the largest firms in Foreign are organized into a single lobby, substituting in the respective objective functions, and making use of (3.9) and (3.10) yields

$$\begin{aligned}\bar{G} &= \phi^F \phi \left(\pi_{HD}^{agg}(\beta) + \pi_{HE}^{agg}(\beta_F) + L_H \left(\mu \ln \frac{\mu}{P_H(\beta)} - \mu \right) \right) + \phi^F C^L(\beta, \beta_F) \\ &\quad + \phi \, \phi^F \left(\pi_{FD}^{agg}(\beta_F) + \pi_{FE}^{agg}(\beta) + L_F \left(\mu \ln \frac{\mu}{P_F(\beta_F)} - \mu \right) \right) + \phi \, C_F^L(\beta, \beta_F) \\ &= \phi^F \phi \left((L_H + L_F) \frac{\mu}{\kappa} \frac{\sigma - 1}{\sigma} + L_H \left(\mu \ln \frac{\mu}{P_H(\beta)} - \mu \right) + L_F \left(\mu \ln \frac{\mu}{P_F(\beta_F)} - \mu \right) \right) \\ &\quad + \phi^F C^L(\beta, \beta_F) + \phi \, C_F^L(\beta, \beta_F).\end{aligned} \tag{3.21}$$

The structure of the problem $\max_{\beta \in [1,\bar{\beta}], \beta_F \in [1,\bar{\beta}_F]} \bar{G}$ is however equivalent to the structure of the problem considered in section 3.4.3, and we can apply the result of Bernheim and Whinston (1986) again. With truthful contribution schedules, this amounts to the following first order condition for the equilibrium level of border measures β^o in Home:

$$\phi^F \phi \left(-L_H \frac{\mu}{P_H(\beta^o)} \frac{\partial P_H(\beta^o)}{\partial \beta} \right) + \phi^F \frac{\partial \pi^L_{HD}(\beta^o)}{\partial \beta} + \phi \frac{\partial \pi^L_{FE}(\beta^o)}{\partial \beta} = 0 \tag{3.22}$$

Using the definition of social welfare in Home and taking into account that $\frac{\partial \pi^{agg}_{HD}(\beta)}{\partial \beta} = -\frac{\partial \pi^{agg}_{FE}(\beta)}{\partial \beta}$, this is equivalent to

$$\underbrace{\phi \frac{\partial W(\beta^o)}{\partial \beta}}_{<0} + \underbrace{\frac{\partial \pi^L_{HD}(\beta^o)}{\partial \beta}}_{>0} + \underbrace{\phi \frac{\partial \pi^{agg}_{FE}(\beta^o)}{\partial \beta}}_{<0} + \underbrace{\frac{\phi}{\phi^F} \frac{\partial \pi^L_{FE}(\beta^o)}{\partial \beta}}_{>0 \text{ or } <0} = 0 \tag{3.23}$$

The first two summands capture the effects of border measures which are already known from the noncooperative case, that is their negative effect on social welfare in Home, and their positive effect on the profits of the Home firms organized into a lobby. The third term reflects the negative effect of border measures in the Home country on the Foreign profits from exporting. In the noncooperative case, this negative externality is not taken into account by the Home government, which may result in border measures which are inefficiently high from a global social welfare perspective. And finally, the fourth summand captures the political pressure which the lobbying firms in Foreign exert on their government to make it plead for customs and administrative procedures in their favor at the negotiating table. The most efficient Foreign firms may actually prefer a positive level of protection, as it allows them to grab the market shares of the less efficient Foreign exporters. If the Foreign government puts a relatively high weight on social welfare, it will however hardly respond to this pressure. Summing up, when both national governments are susceptible to political pressure, the effect of multilateral negotiations on the level of protection is ambiguous, since even if they can remedy inefficiencies in terms of social welfare, they add political pressure from lobbying groups abroad.

3.5.3 Endogenous lobby formation

Until now I have assumed that only the most efficient Home firms lobby and that the least efficient lobby member, characterized by marginal costs a_L, is exogenously given. Such an assumption may seem acceptable as it is in line with the empirical evidence and gives rather clear results. However, in reality no Home firm can be forced to be part of the lobby, and if I want a_L to reflect the equilibrium composition of the lobby, I have to ensure that indeed no Home firm with marginal costs lower than a_L wants to exit the lobby, and that no Home firm with marginal costs higher than a_L wants to joint the lobby, respectively. Therefore, in the following, I will endogenize a_L, and I will do so for the lobbying game about behind-the-border measures. The same idea and procedure is however also applicable to the lobbying game about border measures.

First note that with a continuum of lobby members, each Home firm has only a negligible impact on the level of behind-the-border measures in the political equilibrium. Thus, any Home firm in the lobby essentially has an incentive to free ride on the activities of the other lobby members. It could exit the lobby, save its share in the political contributions of the lobby, and nevertheless benefit from behind-the-border measures implemented in response to the pressure of the Home firms which are still members of the lobby. In the end, with a continuum of Home firms, if each Home firm compares its utility from being in the lobby with its utility from abstaining from it, it is hard to argue why any lobby should exist after all.

A very neat way to circumvent such a dilemma is the sincere lobbying approach suggested by Zudenkova (2008). Translated into the present modeling framework, the idea is that if a Home firm wants the lobby to exist, it also wants to be a member of the lobby and bear its share of the lobby's political contributions. The equilibrium condition for the lobby formation process then is that no Home firm which is a member of the lobby wants the lobby to stop existing. The motivation behind such an equilibrium condition is that Home firms derive a satisfaction from showing their loyalty to a lobby group which defends their interest. Also, social norms may forbid free riding on the efforts of others.

If all lobby members would have to bear an equal share of the lobby's political contributions, such an equilibrium condition would lead to a critical value a_L, such that a Home firm with a_L is just indifferent between being a member of the lobby and paying a share of the contributions and a political equilibrium without the lobby. All Home firms with marginal costs lower than a_L strictly prefer the lobby to exist, since their gain from the implementation of behind-the-border measures is larger than their share in political contributions. All Home firms with marginal costs higher than a_L gain so little from the lobby's activities that they are not willing to bear their share in political contributions, and hence prefer to have no lobby.

Formally, a Home firm is a member of the lobby and prefers the lobby to exist if

$$\pi_{HD}(a, \alpha^o) - \frac{C_L^T(\alpha^o)}{M_H \int_0^{a_L} dH(a)} > \pi_{HD}(a, \alpha = 1) \tag{3.24}$$

where α^o characterizes the level of behind-the-border measures that results if the lobby exerts political pressure on the Home government. Note that a Home firm's profits from exporting to the Foreign market are independent of whether a lobby does or does not exist. The gain from the implementation of behind-the-border measures, $\pi_{HD}(a, \alpha^o) - \pi_{HD}(a, \alpha = 1)$, is strictly decreasing in marginal costs a and becomes negative if a is sufficiently large. Hence, there exists a critical level of marginal costs a_L for which a Home firm is just indifferent between being a member of the lobby and not having a

lobby after all. This critical level a_L indicates the composition of the lobby and is given by

$$\pi_{HD}(a_L, \alpha^o) - \frac{C_L^T(\alpha^o)}{M_H \int_0^{a_L} dH(a)} = \pi_{HD}(a_L, \alpha = 1) \tag{3.25}$$

which is equivalent to

$$\begin{aligned} \frac{\mu}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} L_H P_H(\alpha^o)^{\sigma-1} a_L^{1-\sigma} - \alpha^o f_{HD} - \frac{\phi\mu L_H \frac{\kappa+1-\sigma}{(\sigma-1)\kappa} \ln \alpha^o}{M_H \left(\frac{a_L}{\bar{a}_H}\right)^{\kappa}} \\ = \frac{\mu}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} L_H P_H(\alpha=1)^{\sigma-1} a_L^{1-\sigma} - f_{HD} \end{aligned} \tag{3.26}$$

Since contributions as well as profits change with the level of behind-the-border measures, the critical level a_L is an implicit function of the policy α^o that results in the equilibrium of the lobbying game. This equilibrium policy α^o in turn depends on the composition of the lobby and hence on a_L, as can be seen from the first order condition (3.18) for a truthful interior equilibrium. Hence, I have two equations in two unknowns, a_L and α^o. Given the non-linear structure of the underlying functions, however, solving this system of equations requires numerical methods. Yet, even if it does not lead to an explicit analytical solution, the sincere lobbying approach seems to be a neat and tractable way to endogenize the lobby formation process.

3.6 Conclusion

Starting from the observation that the traditional "Protection for Sale" model of Grossman and Helpman (1994) does not address a couple of interesting issues, the present paper has proposed a different framework to model lobbying on trade policy. It allows for intra-industry trade between countries, heterogeneous lobbying activities of firms, and non-tariff barriers to trade such as technical standards or customs and administrative procedures as relevant policy instruments.

Technical standards, which are applied to both domestic firms and foreign exporters and are thus called behind-the-border measures, shift profits within countries, from the least efficient to the most efficient firms. Behind-the-border measures may also shift profits across countries, but not necessarily in the direction of the country that is more productive on average. In any case, from a pure social welfare perspective, it is never optimal to introduce such measures. With only the largest firms lobbying, they may nevertheless be an equilibrium outcome, and the model suggests that the level of such anti-competitive regulations will be the larger, the more restricted trade already is, and the less the government cares about social welfare.

Border measures, in contrast, clearly discriminate against foreign exporters. They unambiguously benefit domestic producers, and shift profits away from the foreign country. Yet, they also raise prices for consumers, and since this negative effect always dominates the positive effect on profits, border measures will never be chosen by a government that is solely interested in social welfare. Even if the government is susceptible to political pressure, it may choose not to implement any protectionists measures at all. If it implements such measures however, it will chose the maximum possible level to prevent foreign exporters from market entry.

Possible extensions of the model include positive welfare effects of behind-the-border measures, interactions between national governments, and endogenous lobby formation. The last issue requires numerical simulations for specific parameter constellations, but promises interesting results. Another avenue for further research is to allow for the possibility of foreign lobbying. And finally, the model derives a set of predictions which are, in principle, empirically testable, given appropriate data on firm productivities, lobbying expenditures and the level of non-tariff barriers to trade.

The results in this paper are derived in a specific political economy setup, which has been argued to be a valid description of the trade policy formation process in the United States (Grossman and Helpman, 1994). For the European Union, however, the political economy setup may not be as appropriate, and a natural question is whether the results generalize to the institutional environment which shapes European trade policy. Within the European Union, trade policies are generally proposed by the European Commission as a supranational institution, and decided upon by the Council of Ministers as an intergovernmental institution by majority voting. Lobbying may take place at the international level by exerting political pressure on the European Commission or at the national level by trying to influence the members of the Council of Ministers. Regarding non-tariff barriers to trade, lobbying the national governments is relatively more important, as individual member states still have considerable discretion in implementing trade policies in disguise. In the European Union, rather than swaying bureaucrats' and politicians' favors by financial contributions, special interest groups provide selective information to uninformed decision makers to take legislative influence. Only a few attempts have been made to capture these complex institutional features (Console Battilani, 2007; Belloc and Guerrieri, 2008). Yet, to the extent that lobbies have to buy access to legislators in order to convey their arguments, it stands to reason that trade policy will still be biased towards the interest of large firms, as only they will be able to incur the costs of maintaining an office in Brussels, for instance. Nevertheless, a thorough analysis of the European institutional environment and the role of individual firms in European trade policy formation process remains to be done in future research.

Appendix

Appendix A: Explicit solutions for price indices, cutoff values and profits

Using $a_{HD} = \left(\frac{f_{HD}}{L_H}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma}{\mu}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma-1}{\sigma}\right) P_H$, $a_{FE} = \left(\frac{f_{FE}}{L_H}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma}{\mu}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma-1}{\sigma}\right) \frac{1}{\tau_H} P_H$, and the marginal cost distributions with identical shape parameters given by (3.5) and (3.6), the price index in Home can be calculated as

$$\begin{aligned} P_H &= \left(M_H \int_0^{a_{HD}} \left(\frac{\sigma}{\sigma-1}\, a\right)^{1-\sigma} dH(a) + M_F \int_0^{a_{FE}} \left(\frac{\sigma}{\sigma-1}\, \tau_H a\right)^{1-\sigma} dF(a) \right)^{\frac{1}{1-\sigma}} \\ &= A \left(M_H \left(\frac{f_{HD}}{L_H}\right)^{\frac{\kappa+1-\sigma}{1-\sigma}} \bar{a}_H^{-\kappa} + M_F \left(\frac{f_{FE}}{L_H}\right)^{\frac{\kappa+1-\sigma}{1-\sigma}} (\tau_H \bar{a}_F)^{-\kappa} \right)^{-\frac{1}{\kappa}}. \end{aligned} \tag{3.27}$$

Similarly, the price index in Foreign can be calculated as

$$\begin{aligned} P_F &= \left(M_H \int_0^{a_{HE}} \left(\frac{\sigma}{\sigma-1}\, \tau_F a\right)^{1-\sigma} dH(a) + M_F \int_0^{a_{FD}} \left(\frac{\sigma}{\sigma-1}\, a\right)^{1-\sigma} dF(a) \right)^{\frac{1}{1-\sigma}} \\ &= A \left(M_F \left(\frac{f_{FD}}{L_F}\right)^{\frac{\kappa+1-\sigma}{1-\sigma}} \bar{a}_F^{-\kappa} + M_H \left(\frac{f_{HE}}{L_F}\right)^{\frac{\kappa+1-\sigma}{1-\sigma}} (\tau_F \bar{a}_H)^{-\kappa} \right)^{-\frac{1}{\kappa}} \end{aligned} \tag{3.28}$$

with $A = \left(\frac{\sigma}{\mu}\right)^{\frac{\kappa+1-\sigma}{\kappa(\sigma-1)}} \left(\frac{\sigma}{\sigma-1}\right) \left(\frac{\kappa}{\kappa+1-\sigma}\right)^{-\frac{1}{\kappa}}$. The corresponding cutoff values are

$$a_{HD} = B \left(\frac{M_H}{L_H} f_{HD} \bar{a}_H^{-\kappa} + \frac{M_F}{L_H} f_{FE}^{\frac{\kappa+1-\sigma}{1-\sigma}} f_{HD}^{-\frac{\kappa}{1-\sigma}} (\tau_H \bar{a}_F)^{-\kappa} \right)^{-\frac{1}{\kappa}} \tag{3.29}$$

$$a_{HE} = B \left(\frac{M_H}{L_F} f_{HE} \bar{a}_H^{-\kappa} + \frac{M_F}{L_F} f_{HE}^{-\frac{\kappa}{1-\sigma}} f_{FD}^{\frac{\kappa+1-\sigma}{1-\sigma}} \tau_F^{\kappa} \bar{a}_F^{-\kappa} \right)^{-\frac{1}{\kappa}} \tag{3.30}$$

$$a_{FD} = B \left(\frac{M_F}{L_F} f_{FD} \bar{a}_F^{-\kappa} + \frac{M_H}{L_F} f_{HE}^{\frac{\kappa+1-\sigma}{1-\sigma}} f_{FD}^{-\frac{\kappa}{1-\sigma}} (\tau_F \bar{a}_H)^{-\kappa} \right)^{-\frac{1}{\kappa}} \tag{3.31}$$

$$a_{FE} = B \left(\frac{M_F}{L_H} f_{FE} \bar{a}_F^{-\kappa} + \frac{M_H}{L_H} f_{FE}^{-\frac{\kappa}{1-\sigma}} f_{HD}^{\frac{\kappa+1-\sigma}{1-\sigma}} \tau_H^{\kappa} \bar{a}_H^{-\kappa} \right)^{-\frac{1}{\kappa}} \tag{3.32}$$

with $B = \left(\frac{\sigma}{\mu}\right)^{-\frac{1}{\kappa}} \left(\frac{\kappa}{\kappa+1-\sigma}\right)^{-\frac{1}{\kappa}}$. Given P_H and P_F, the profits of a firm with marginal costs a can be calculated as

$$\pi_{HD}(a) = C \left(\frac{M_H}{L_H} f_{HD}^{\frac{\kappa+1-\sigma}{1-\sigma}} \bar{a}_H^{-\kappa} + \frac{M_F}{L_H} f_{FE}^{\frac{\kappa+1-\sigma}{1-\sigma}} (\tau_H \bar{a}_F)^{-\kappa} \right)^{\frac{1-\sigma}{\kappa}} a^{1-\sigma} - f_{HD} \quad \text{if } a \le a_{HD} \tag{3.33}$$

$$\pi_{HE}(a) = C\left(\frac{M_F}{L_F} f_{FD}^{\frac{\kappa+1-\sigma}{1-\sigma}} \tau_F^{\kappa} \bar{a}_F^{-\kappa} + \frac{M_H}{L_F} f_{HE}^{\frac{\kappa+1-\sigma}{1-\sigma}} \bar{a}_H^{-\kappa}\right)^{\frac{1-\sigma}{\kappa}} a^{1-\sigma} - f_{HE} \quad \text{if } a \leq a_{HE} \tag{3.34}$$

$$\pi_{FD}(a) = C\left(\frac{M_F}{L_F} f_{FD}^{\frac{\kappa+1-\sigma}{1-\sigma}} \bar{a}_F^{-\kappa} + \frac{M_H}{L_F} f_{HE}^{\frac{\kappa+1-\sigma}{1-\sigma}} (\tau_F \bar{a}_H)^{-\kappa}\right)^{\frac{1-\sigma}{\kappa}} a^{1-\sigma} - f_{FD} \quad \text{if } a \leq a_{FD} \tag{3.35}$$

$$\pi_{FE}(a) = C\left(\frac{M_H}{L_H} f_{HD}^{\frac{\kappa+1-\sigma}{1-\sigma}} \tau_H^{\kappa} \bar{a}_H^{-\kappa} + \frac{M_F}{L_H} f_{FE}^{\frac{\kappa+1-\sigma}{1-\sigma}} \bar{a}_F^{-\kappa}\right)^{\frac{1-\sigma}{\kappa}} a^{1-\sigma} - f_{FE} \quad \text{if } a \leq a_{FE} \tag{3.36}$$

and zero otherwise, with $C = \left(\frac{\sigma}{\mu}\right)^{\frac{1-\sigma}{\kappa}} \left(\frac{\kappa}{\kappa+1-\sigma}\right)^{\frac{1-\sigma}{\kappa}}$.

Appendix B: Proof of proposition 3.1

Integrating individual profits given by (3.3) over all Home firms active on the domestic market, with $a_{HD} = \left(\frac{\alpha f_{HD}}{L_H}\right)^{1/(1-\sigma)} \left(\frac{\sigma}{\mu}\right)^{1/(1-\sigma)} \left(\frac{\sigma-1}{\sigma}\right) P_H$ and $H(a) = \left(\frac{a}{\bar{a}_H}\right)^{\kappa_H}$, gives aggregate domestic profits of Home firms as a function of the price index P_H,

$$\pi_{HD}^{agg} = M_H \int_0^{a_{HD}} \pi_{HD}(a) dH(a) = L_H \frac{M_H}{\bar{a}_H^{\kappa_H}} \frac{\sigma-1}{\kappa_H+1-\sigma} \left(\frac{\sigma}{\mu}\right)^{\frac{\kappa_H}{1-\sigma}} \left(\frac{\sigma-1}{\sigma}\right)^{\kappa_H} \left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}} P_H^{\kappa_H} \tag{3.37}$$

Differentiating with respect to α, taking into account that P_H itself depends on α, and rearranging yields

$$\frac{\partial \pi_{HD}^{agg}}{\partial \alpha} = L_H \frac{M_H}{\bar{a}_H^{\kappa_H}} \left(\frac{\sigma}{\mu}\right)^{\frac{\kappa_H}{1-\sigma}} \left(\frac{\sigma-1}{\sigma}\right)^{\kappa_H} \left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}} \frac{P_H^{\kappa_H}}{\alpha} \left(\frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma} \epsilon_{P_H,\alpha} - 1\right) \tag{3.38}$$

where $\epsilon_{P_H,\alpha}$ is the elasticity of the price index P_H with respect to α. Hence,

$$\frac{\partial \pi_{HD}^{agg}}{\partial \alpha} \begin{cases} > 0 & \text{if } \frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma} \epsilon_{P_H,\alpha} > 1 \\ = 0 & \text{if } \frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma} \epsilon_{P_H,\alpha} = 1 \\ < 0 & \text{if } \frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma} \epsilon_{P_H,\alpha} < 1 \end{cases} \tag{3.39}$$

With $a_{FE} = \left(\frac{\alpha f_{FE}}{L_H}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma}{\mu}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma-1}{\sigma}\right) \frac{P_H}{\tau_H}$ and $F(a) = \left(\frac{a}{\bar{a}_F}\right)^{\kappa_F}$, the equilibrium price index in Home is implicitly given by

$$0 = \frac{\sigma}{\mu}\left(D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}} P_H^{\kappa_H} + E\left(\frac{\alpha f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}} P_H^{\kappa_F}\right) - 1. \tag{3.40}$$

with $D = \frac{M_H}{\bar{a}_H^{\kappa_H}} \frac{\kappa_H}{\kappa_H+1-\sigma} \left(\frac{\sigma}{\mu}\right)^{\frac{\kappa_H}{1-\sigma}} \left(\frac{\sigma-1}{\sigma}\right)^{\kappa_H}$ and $E = \frac{M_F}{\bar{a}_F^{\kappa_F}} \frac{\kappa_F}{\kappa_F+1-\sigma} \left(\frac{\sigma}{\mu}\right)^{\frac{\kappa_F}{1-\sigma}} \left(\frac{\sigma-1}{\sigma}\right)^{\kappa_F} \tau_H^{-\kappa_F}$.
Using the implicit function theorem and calculating the elasticity of the price index P_H with respect to α yields

$$\frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma}\,\epsilon_{P_H,\alpha}=\frac{D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}\kappa_H+E\left(\frac{\alpha f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}}P_H^{\kappa_F}\,\frac{\kappa_F+1-\sigma}{\kappa_H+1-\sigma}\kappa_H}{D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}\kappa_H+E\left(\frac{\alpha f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}}P_H^{\kappa_F}\,\kappa_F}. \tag{3.41}$$

Thus, $\frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma}\,\epsilon_{P_H,\alpha}>1$ and $\frac{\partial\pi_{HD}^{agg}}{\partial\alpha}>0$ if $\frac{\kappa_F+1-\sigma}{\kappa_H+1-\sigma}\kappa_H>\kappa_F$, or, equivalently, if $\kappa_H<\kappa_F$. Further, $\frac{\partial\pi_{HD}^{agg}}{\partial\alpha}<0$ if $\kappa_H>\kappa_F$ and $\frac{\partial\pi_{HD}^{agg}}{\partial\alpha}=0$ if $\kappa_H=\kappa_F$. The proof for $\frac{\partial\pi_{FE}^{agg}}{\partial\alpha}$ follows analogously. ■

Appendix C: Proof of proposition 3.2

Differentiating (3.11) with respect to α using (3.38) gives

$$\begin{aligned}\frac{\partial W}{\partial\alpha}&=\frac{\partial\pi_{HD}^{agg}}{\partial\alpha}-L_H\mu\frac{1}{P_H}\frac{\partial P_H}{\partial\alpha}\\&=\frac{L_H}{\alpha}\,\frac{M_H}{\bar{a}_H^{\kappa_H}}\left(\frac{\sigma}{\mu}\right)^{\frac{\kappa_H}{1-\sigma}}\left(\frac{\sigma-1}{\sigma}\right)^{\kappa_H}\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}\left(\frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma}\,\epsilon_{P_H,\alpha}-1\right)\\&\quad-\frac{L_H}{\alpha}\mu\,\epsilon_{P_H,\alpha}\\&=\frac{L_H}{\alpha}\frac{\kappa_H+1-\sigma}{\kappa_H}D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}\left(\frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma}\,\epsilon_{P_H,\alpha}-1\right)-\frac{L_H}{\alpha}\mu\,\epsilon_{P_H,\alpha}.\end{aligned} \tag{3.42}$$

Substituting μ in the second summand of equation (3.42) using the implicit solution (3.40) for the price index in Home gives

$$\begin{aligned}\frac{\partial W}{\partial\alpha}&=\frac{L_H}{\alpha}\frac{\kappa_H+1-\sigma}{\kappa_H}D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}\left(\frac{(\sigma-1)\kappa_H}{\kappa_H+1-\sigma}\,\epsilon_{P_H,\alpha}-1\right)\\&\quad-\frac{L_H}{\alpha}\sigma\left(D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}+E\left(\frac{\alpha f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}}P_H^{\kappa_F}\right)\epsilon_{P_H,\alpha}\\&=\frac{L_H}{\alpha}(\sigma-1)D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}\epsilon_{P_H,\alpha}-\frac{L_H}{\alpha}\sigma D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}\epsilon_{P_H,\alpha}\\&\quad-\frac{L_H}{\alpha}\frac{\kappa_H+1-\sigma}{\kappa_H}D\left(\frac{\alpha f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}}P_H^{\kappa_H}-\frac{L_H}{\alpha}\sigma E\left(\frac{\alpha f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}}P_H^{\kappa_F}\epsilon_{P_H,\alpha}\\&<0\end{aligned} \tag{3.43}$$

since $\epsilon_{P_H,\alpha}>0$. ■

Appendix D: Proof of proposition 3.3

First note that with border measures, the price index in Home is implicitly given by

$$0 = \frac{\sigma}{\mu}\left(D\left(\frac{f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}} P_H^{\kappa_H} + E\left(\frac{\beta f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}} P_H^{\kappa_F}\right) - 1. \tag{3.44}$$

Differentiating with respect to β using the implicit function theorem and multiplying with $\frac{\beta}{P_H}$ gives

$$\epsilon_{P_H,\beta} = \frac{\frac{\kappa_F+1-\sigma}{\sigma-1}\, E\, \left(\frac{\beta f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}} P_H^{\kappa_F}}{\kappa_H D\left(\frac{f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}} P_H^{\kappa_H} + \kappa_F E\left(\frac{\beta f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}} P_H^{\kappa_F}} > 0 \tag{3.45}$$

Now, differentiating social welfare as given by equation (3.11) with respect to β yields

$$\begin{aligned}
\frac{\partial W}{\partial \beta} &= \frac{\partial \pi_{HD}^{agg}}{\partial \beta} - L_H \mu \frac{1}{P_H}\frac{\partial P_H}{\partial \beta} \\
&= \frac{L_H}{\beta}\left(\frac{M_H}{\bar{a}_H^{\kappa_H}}\,\frac{\kappa_H(\sigma-1)}{\kappa_H+1-\sigma}\left(\frac{\sigma}{\mu}\right)^{\frac{\kappa_H}{1-\sigma}}\left(\frac{\sigma-1}{\sigma}\right)^{\kappa_H}\left(\frac{f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}} P_H^{\kappa_H} - \mu\right)\epsilon_{P_H,\beta} \\
&= \frac{L_H}{\beta}\left((\sigma-1)D\left(\frac{f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}} P_H^{\kappa_H} - \mu\right)\epsilon_{P_H,\beta}.
\end{aligned} \tag{3.46}$$

Substituting μ in the second part of equation (3.46) using the implicit solution (3.44) for the price index in Home and rearranging gives

$$\frac{\partial W}{\partial \beta} = \frac{L_H}{\beta}\left(-D\left(\frac{f_{HD}}{L_H}\right)^{\frac{\kappa_H+1-\sigma}{1-\sigma}} P_H^{\kappa_H} - \sigma E\left(\frac{\beta f_{FE}}{L_H}\right)^{\frac{\kappa_F+1-\sigma}{1-\sigma}} P_H^{\kappa_F}\right)\epsilon_{P_H,\beta} < 0. \tag{3.47}$$

■

Appendix E: Proof of proposition 3.5

With truthful contribution schedules and differentiable profit functions, any equilibrium policy that lies in the interior of $[1, \bar{\alpha}]$ must satisfy $\phi\frac{\partial W(\alpha^o)}{\partial \alpha} + \frac{\partial W_L(\alpha^o)}{\partial \alpha} = 0$, which is equivalent to $\phi\frac{\partial W(\alpha^o)}{\partial \alpha} + \frac{\partial \pi_{HD}^L(\alpha^o)}{\partial \alpha} = 0$. Taking the first, second and third derivative of (3.17) with respect to α, using $\epsilon_{P_H,\alpha} = \frac{\kappa+1-\sigma}{(\sigma-1)\kappa}$, shows that the marginal gain in contributions, $\frac{\partial \pi_{HD}^L(\alpha)}{\partial \alpha}$, is positive, decreasing and convex in α until it reaches zero at $\alpha = \alpha_L$. Taking the first, second and third derivative of equation (3.11) with respect to α, taking into account $\frac{\partial \pi_{HD}^{agg}}{\partial \alpha} = \frac{\partial \pi_{HE}^{agg}}{\partial \alpha} = 0$ and $\epsilon_{P_H,\alpha} = \frac{\kappa+1-\sigma}{(\sigma-1)\kappa}$, shows that the marginal loss in social welfare, $-\phi\frac{\partial W(\alpha)}{\partial \alpha}$, is positive, decreasing, convex, and converges to zero as α goes to infinity. Restricting parameters such that $\phi\frac{\partial W(\alpha)}{\partial \alpha} + \frac{\partial \pi_{HD}^L(\alpha)}{\partial \alpha} > 0 \Leftrightarrow -\phi\frac{\partial W(\alpha)}{\partial \alpha} < \frac{\partial \pi_{HD}^L(\alpha)}{\partial \alpha}$ at $\alpha = 1$ ensures that $-\phi\frac{\partial W(\alpha)}{\partial \alpha}$ and $\frac{\partial \pi_{HD}^L(\alpha)}{\partial \alpha}$ cross exactly once in the interior of the interval

$[1, \bar{\alpha}]$, provided that $\bar{\alpha} > \alpha_L$, and hence $-\phi\frac{\partial W(\alpha^o)}{\partial \alpha} = \frac{\partial \pi^L_{HD}(\alpha^o)}{\partial \alpha} \Leftrightarrow \phi\frac{\partial W(\alpha^o)}{\partial \alpha} + \frac{\partial \pi^L_{HD}(\alpha^o)}{\partial \alpha} = 0$ characterizes α^o as the unique equilibrium level of behind-the-border measures resulting from the lobbying game. ■

Appendix F: Proof of proposition 3.7

With truthful contribution schedules, the Home government acts as if it were maximizing $\phi W(\beta) + W_L(\beta)$, which is equivalent to $\phi W(\beta) + \pi^L_{HD}(\beta) + \pi^L_{HE}$. Suppose $\phi\frac{\partial W(\beta)}{\partial \beta} + \frac{\partial \pi^L_{HD}(\beta)}{\partial \beta} > 0$ at $\beta = 1$. This implies that $\frac{\beta}{L_H \epsilon_{P_H,\beta}}\phi\frac{\partial W(\beta)}{\partial \beta} + \frac{\beta}{L_H \epsilon_{P_H,\beta}}\frac{\partial \pi^L_{HD}(\beta)}{\partial \beta} > 0$ at $\beta = 1$ since $\epsilon_{P_H,\beta} > 0$. Both $\frac{\beta}{L_H \epsilon_{P_H,\beta}}\phi\frac{\partial W(\beta)}{\partial \beta}$ and $\frac{\beta}{L_H \epsilon_{P_H,\beta}}\frac{\partial \pi^L_{HD}(\beta)}{\partial \beta}$ are increasing in β, since both

$$\frac{\beta}{L_H \epsilon_{P_H,\beta}}\phi\frac{\partial W(\beta)}{\partial \beta} = \phi\left(\frac{M_H}{\bar{a}_H^{\kappa}}\left(\frac{\sigma}{\mu}\right)^{\frac{\kappa}{1-\sigma}}\left(\frac{\sigma-1}{\sigma}\right)^{\kappa} P_H(\beta)^{\kappa}\left(\frac{f_{HD}}{L_H}\right)^{\frac{\kappa+1-\sigma}{1-\sigma}}\frac{\kappa(\sigma-1)}{\kappa+1-\sigma} - \mu\right) \tag{3.48}$$

and

$$\frac{\beta}{L_H \epsilon_{P_H,\beta}}\frac{\partial \pi^L_{HD}(\beta)}{\partial \beta} = M_H\left(\frac{a_L}{\bar{a}_H}\right)^{\kappa}\frac{\mu}{\sigma}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1} P_H(\beta)^{\sigma-1} a_L^{1-\sigma}\frac{\kappa(\sigma-1)}{\kappa+1-\sigma} \tag{3.49}$$

depend positively on $P_H(\beta)$ and $\frac{\partial P_H(\beta)}{\partial \beta} > 0$. Hence $\frac{\beta}{L_H \epsilon_{P_H,\beta}}\phi\frac{\partial W(\beta)}{\partial \beta} + \frac{\beta}{L_H \epsilon_{P_H,\beta}}\frac{\partial \pi^L_{HD}(\beta)}{\partial \beta} > 0$ must hold for all $\beta \in [1, \bar{\beta}]$, which implies that $\phi\frac{\partial W(\beta)}{\partial \beta} + \frac{\partial \pi^L_{HD}(\beta)}{\partial \beta} > 0$ must also hold for all $\beta \in [1, \bar{\beta}]$. Thus, the first derivative of the Home government's objective function is positive for all $\beta \in [1, \bar{\beta}]$ and hence the Home governments welfare has a unique maximum at $\beta^o = \bar{\beta}$.

Now suppose $\phi\frac{\partial W(\beta)}{\partial \beta} + \frac{\partial \pi^L_{HD}(\beta)}{\partial \beta} < 0$ at $\beta = \bar{\beta}$. Following the same line of arguments as above, this implies that the first derivative of the Home governments objective function is negative for all $\beta \in [1, \bar{\beta}]$ and hence the Home governments welfare has a unique maximum at $\beta^o = 1$. ■

Chapter 4

Firm size and the choice of export mode

4.1 Introduction

In international trade theory, it is typically assumed that manufacturing firms which want to serve the foreign market ship their products directly to their final consumers. What we observe in reality, however, is that very often trade intermediaries are involved in the exchange of goods and services across borders. Intermediaries are *"... economic agents that purchase from suppliers for resale to buyers or that help buyers and sellers to meet and transact"* (Spulber, 1996). If buyers and sellers are based in different countries, these agents are trade intermediaries. They include wholesalers and retailers in the exporting and importing country as well as large trading companies. In the 1990s, for instance, Japanese trading companies exported over 40% and imported over 70% of the country's products (Jones, 1998), and Hong Kong intermediated over 50% of the volume of China's exports to the rest of the world (Feenstra et al., 2004). Survey evidence suggests that in 2003 in Germany, 47% of all firms with foreign customers exported directly, while 44% sold their goods abroad indirectly via a trade intermediary (Fryges, 2007).

Only recently, researchers have started to explore why firms may prefer using a trade intermediary to ship their goods to exporting directly. Not surprisingly, the choice of export mode depends on destination country characteristics, such as the size of the foreign market (Schröder et al., 2005), the risk of expropriation and the enforceability of international contracts, or the cultural distance to the target country (Felbermayr and Jung, 2009).

However, another important insight that emerges from new theoretical contributions on the choice of export mode is that all else equal, smaller firms prefer to export their

products via trade intermediaries, while larger firms prefer to sell their goods abroad directly. Ahn et al. (2010) introduce an intermediation technology in an otherwise standard heterogeneous firm model of international trade. As in the seminal model of Melitz (2003), firms can ship their goods directly if they incur a fixed cost of exporting. Alternatively, firms can export their products via an intermediary at a lower fixed cost, but at an additional marginal costs. In the presence of such an intermediation technology, firms sort into export modes according to their sizes. The smallest firms do not export at all and sell to the domestic market only. Larger firms export indirectly via a trade intermediary, and the largest firms export directly to the final consumers.

A similar approach is taken by Felbermayr and Jung (2009). In contrast to Ahn et al. (2010), however, they do not simply assume that the marginal costs of trading indirectly are higher and thus export revenues are lower, but derive this as a result of the imperfect enforceability of contracts between exporters and trade intermediaries. Due to this distortion, larger exporters prefer to incur the higher fixed costs of building their own distribution network and export their goods directly. For smaller exporters trading via an intermediary is nevertheless attractive, as it helps them to save on the fixed costs of exporting.

Blum et al. (2009) consider a search and matching model in which both exporters and final consumers expend resources to find and match with an appropriate trading partner. An exporter can match with a final consumer in the foreign country either directly or indirectly by matching with a trade intermediary who then matches with a final consumer. If the exporter is large, it is highly visible and easy to identify by final consumers in the foreign country. In this case, matching directly is efficient. On the contrary, if the exporter is rather small, it is less likely to be found by potential foreign customers and would have to spend considerable resources to match directly with a final consumer. Therefore, the smaller exporter better matches with a large trade intermediary who then matches with a final consumer. A large trade intermediary makes matching cheaper, not only because it is easier to identify by both exporters and foreign customers, but also because it pools the costs of matching and spreads them over many exporters and final consumers.[1]

Although the theoretical literature provides clear results on the relationship between firm size and the choice of export mode, to date there is very little evidence whether these results are also empirically valid. The present papers fills this gap and uses data from the World Bank Enterprise Survey conducted in Turkey in 2008 to evaluate whether smaller firms do indeed rely more heavily on trade intermediaries. In addition to information about a variety of firm characteristics, the survey provides information about the share

[1] A similar argument has been made by Rauch and Watson (2002), who show that trade intermediaries can draw on strong networks and thereby facilitate matches between domestic sellers and foreign buyers. The relevance of formal and informal networks for shaping bilateral trade relations has been emphasized among others by Rauch (1999), Rauch and Trindade (2002) and Combes et al. (2005).

of revenues generated by selling domestically, by exporting directly, and by exporting indirectly via a trade intermediary. It covers a comparatively large representative sample of Turkish firms in terms of firm size, and includes both exporters and non-exporters from a broad range of manufacturing sectors. An indisputable drawback of the data is that it does not contain any information on the destination of a firm's exports. However, I will argue that if the number and the identity of a firm's export markets depends on the firm's size, there is still a clear prediction regarding the relationship between firm size and the share of indirect exports in total exports. A small firm will start exporting indirectly to a foreign market which is easily accessible. A large firm will deliver to the same market rather directly. Even if it uses a trade intermediary to enter into additional foreign markets, which are most likely less accessible, the share of indirect exports in total exports will be lower as it is for a small firm. In other words, if I do not control for the number of destination countries served, I would underestimate the negative relationship between firm size and the relative prevalence of intermediated exports.

In fact, the empirical analysis suggests that the share of indirect exports in total exports declines significantly with firm size, and this result is robust to the inclusion of a variety of control variables, different estimation methods and different measures of firm size. In particular, adding proxies for firm age, management experience, ownership structure, legal status or research and development activities has no effect on the sign or significance of the estimated coefficient of firm size. Going beyond ordinary least squares regressions and applying a non-linear quasi-maximum likelihood estimator developed for fractional dependent variables does not change the main conclusions either, nor does it matter whether sales or employees are used as a measure of firm size.

I further find that firms which are part of a larger company export a larger fraction of their goods indirectly, which is in line with the idea that these firms trade relatively more intermediate inputs and unfinished goods with each other, and export relatively less final goods which are potentially shipped directly to the final consumer. Having a highly skilled workforce and developing new and innovative products is generally associated with relatively less indirect exports, which is consistent with the argument that technically more sophisticated products require more direct contact to the customers, and that innovative firms prefer a higher level of control.

As already pointed out, evidence on the relationship between firm size and the choice of export mode is scarce. Using census data on exports of U.S. firms, Felbermayr and Jung (2009) relate the relative prevalence of trade intermediaries to destination country characteristics as well as to the dispersion of firm size across industries. They find that industries with a higher size dispersion exhibit a significantly lower relative prevalence of trade intermediaries, a result that is consistent with their prediction regarding the sorting pattern of firms into different export modes. However, they do not provide direct evidence at the firm level regarding the relationship between firm size and the choice of export mode. Analyzing survey data of German and British firms, Fryges (2007)

identifies the factors that drive firms to switch between different export modes. Controlling for destination country characteristics, he finds that firm size has a significantly positive effect on the probability to change from indirect exports to direct exports, and interprets his result as evidence for the claim that larger exporters are more likely to dispose of sufficient resources to establish their own distribution network abroad. However, his sample is rather small and covers only young firms in high-tech industries. Hessels and Terjesen (2010) also provide evidence on the determinants of the choice of export mode at the firm level. For a sample of small and medium sized enterprises in the Netherlands, they find no significant effect of firm size on the probability to export indirectly as opposed to directly, which is presumably due to their very small sample which basically excludes the largest firms in the economy.

In the following section, I sketch a very simple and highly stylized model on the relationship between firm size and the choice of export mode to capture the main arguments from the literature and to clarify the basic idea. In section 4.3, I derive some testable hypotheses on the relationship between firm size and the choice of a trade intermediary. I briefly describe the data in section 4.4 before I show the results of the empirical analysis in section 4.5. In section 4.6, I address the robustness of the results, before I summarize and conclude in section 4.7.

4.2 A simple model

There are two symmetric countries each of which is populated by a mass L of consumers with identical preferences over a continuum of varieties of a differentiated good,

$$U = \left(\int c_i^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}} \tag{4.1}$$

with $\sigma > 1$. The assumption of symmetry is not crucial for the results and can easily be relaxed. Each consumer inelastically supplies one unit of labor, and the wage rate is normalized to one. Aggregate demand in each country for each variety i is

$$q_i = \frac{L p_i^{-\sigma}}{P^{1-\sigma}} \tag{4.2}$$

where p_i is the consumer price of variety i and $P = \left(\int p_i^{1-\sigma} di \right)^{\frac{1}{1-\sigma}}$ is the ideal price index over all consumed varieties.

The differentiated good is produced with increasing returns to scale under monopolistic competition, which implies that each variety will be produced by at most one firm, and no firm will produce more than one variety. To produce one unit of variety i for its domestic market, firm i requires a_i units of labor. Firms differ in their marginal costs

a_i. As in Melitz (2003), they can learn about their marginal costs only after they have made a fixed investment of f_E units of labor, which is thereafter sunk. In addition to the variable costs of production, there are fixed distribution costs of f units of labor, which reflect the resources needed to build a distribution network, to maintain customer relations or to meet specific product standards.

If a firms wants to sell its variety abroad, it has the choice between two different export modes. It can either ship its products directly to the final consumers. In this case, the firm has to incur iceberg trade costs $\tau_D > 1$, which reflect transport costs, import tariffs and other variable costs related to shipping the product abroad. In addition, the firm has to pay fixed distribution costs of f_D units of labor. Alternatively, the firm can use a trade intermediary. Exporting indirectly via a third party causes iceberg trade costs $\tau_I > 1$ and fixed distribution costs of f_I units of labor. Using both export modes simultaneously to ship goods to a given destination country is never optimal, as this creates unnecessarily high fixed costs.

It is assumed that the variable trade costs of exporting indirectly are higher than the variable trade costs of exporting directly, $\tau_I > \tau_D$. One interpretation is that the higher variable costs of exporting indirectly reflect an additional markup charged by the trade intermediary (Ahn et al., 2010). Another reason might be that the contract between the firm and the trade intermediary is not enforceable, and hence the trade intermediary has an incentive to hold up the manufacturer, which leads to lower export revenues (Felbermayr and Jung, 2009).[2]

Further, the fixed distribution costs associated with indirect exporting are assumed to be lower than the fixed costs of exporting directly, $f_I < f_D$. Intuitively, trade intermediaries can spread the fixed costs of building and maintaining a distribution network across many manufacturers and thus lower them for each individual firm (Schröder et al., 2005). In addition, a trade intermediary is more familiar with the target market and draws on strong networks, making access to this market cheaper (Felbermayr and Jung, 2009). Finally, for a manufacturing firm searching for a trade intermediary is most likely not as costly as searching for many new customers abroad (Ahn et al., 2010; Blum et al., 2009). In any case, getting access to a distribution network is more expensive abroad than at home, $f < f_I < f_D$.

The profit maximizing consumer price for variety i is $p_i^H = \frac{\sigma}{\sigma-1} a_i$ on the domestic market. On the foreign market, it is $p_i^I = \frac{\sigma}{\sigma-1} \tau_I a_i$ if the good is exported indirectly and $p_i^D = \frac{\sigma}{\sigma-1} \tau_D a_i$ if the good is exported directly. Multiplying prices with the respective

[2]Strictly speaking, higher iceberg trade costs lead to higher marginal costs for the manufacturer, while both the additional markup charged by the trade intermediary and the hold up problem due to incomplete contract enforcement would lead to higher consumer prices, but not to higher marginal costs for the manufacturer. Yet, the effect of higher iceberg trade costs on the revenues and profits of the manufacturer is qualitatively the same as the effect of higher consumer prices. See also the discussion in Felbermayr and Jung (2009) on this point.

quantities and simplifying notation gives the following expressions for the potential sales firm i can make on the domestic and foreign market,

$$s_i^H = A\ \varphi_i \tag{4.3}$$
$$s_i^I = A\ \tau_I^{1-\sigma}\ \varphi_i \tag{4.4}$$
$$s_i^D = A\ \tau_D^{1-\sigma}\ \varphi_i \tag{4.5}$$

where $A \equiv \frac{L}{P^{1-\sigma}} \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}$ captures market conditions such as the size of the population and the aggregate price level, which is determined endogenously, and $\varphi_i = a_i^{1-\sigma}$ is a measure of firm productivity. The potential profits firm i can generate at home or abroad, given aggregate demand in the respective countries, are

$$\pi_i^H = \frac{A}{\sigma}\ \varphi_i - f \tag{4.6}$$
$$\pi_i^I = \frac{A}{\sigma}\ \tau_I^{1-\sigma}\ \varphi_i - f_I \tag{4.7}$$
$$\pi_i^D = \frac{A}{\sigma}\ \tau_D^{1-\sigma}\ \varphi_i - f_D. \tag{4.8}$$

Firm i will be active on the domestic market only if $\pi_i^H \geq 0$. It will export indirectly if $\pi_i^I \geq 0$ and $\pi_i^I > \pi_i^D$, and export directly if $\pi_i^D \geq \pi_i^I$. As marginal costs are constant, the decision to be active on the home market and the decision to export are independent of each other. This defines the following productivity cutoff values for selling on the domestic market, for exporting indirectly, and for exporting directly,

$$\varphi^H = \frac{\sigma f}{A} \tag{4.9}$$
$$\varphi^I = \frac{\sigma f_I}{A\ \tau_I^{1-\sigma}} \tag{4.10}$$
$$\varphi^D = \frac{\sigma(f_D - f_I)}{A\ (\tau_D^{1-\sigma} - \tau_I^{1-\sigma})} \tag{4.11}$$

with $\varphi^H < \varphi^I < \varphi^D$, under the assumption that the difference in fixed export costs is sufficiently large to make indirect exporting attractive for small exporters, $f_D/f_I > (\tau_I/\tau_D)^{\sigma-1}$. The least productive firms with $\varphi_i < \varphi^H$ are not able to cover the fixed distribution costs and exit the market. All firms with $\varphi^H \leq \varphi_i < \varphi^I$ sell their products on the domestic market only, while all firms with $\varphi^I \leq \varphi_i < \varphi^D$ also serve the foreign market via indirect exports. The most productive firms with $\varphi_i \geq \varphi^D$ choose to deliver their products directly to their foreign consumers. The productivity cutoff values, together with the distribution of marginal costs or firm productivities, respectively, determine the aggregate price level.

4.3 Hypotheses on the choice of export mode

The sorting pattern of firms into purely domestic sellers, indirect exporters and direct exporters implies that the share of indirect exports in total exports to a given destination country is

$$S_i = \frac{s_i^I}{s_i^I + s_i^D} = \begin{cases} 1 & \text{if } \varphi^I \leq \varphi_i < \varphi^D \\ 0 & \text{if } \varphi^D \leq \varphi_i \end{cases} \tag{4.12}$$

In a world with a variety of destination countries with different characteristics, such as population size, the aggregate price level or the extent of the fixed and variable trade costs, a strict partitioning into only indirect and only direct exporters will of course not be observed, as the respective productivity cutoff values for different destination countries will overlap. However, I would expect a negative relationship between the share of indirect exports in total exports and firm productivity to persist. Highly productive firms may serve additional countries which are not profitable enough for inefficient firms,[3] and they may even use a trade intermediary if these countries are hardly accessible. Yet, as highly productive firms will also ship their goods directly to markets that inefficient firms can access only via a trade intermediary, their share of indirect exports in total exports will most likely be lower.

Ideally, I would like to test the relationship between indirect exports and firm productivity directly. However, firm productivity is unobserved and has to be estimated from the data. This is inherently problematic and estimates of firm productivity are most likely inconsistent due to simultaneity problems. There are methods to deal with such problems, but they generally require a panel dimension that the survey data I use in this paper is lacking.[4] Therefore, I will use firm size as measured by employment as a proxy for firm productivity instead. Employment is observable, and it is positively correlated with firm productivity. To see this, note that the labor used by a firm with productivity φ_i to produce and distribute its variety on the domestic and foreign market is

$$l_i = \begin{cases} A\,\frac{\sigma-1}{\sigma}\,\varphi_i + f & \text{if } \varphi^H \leq \varphi_i < \varphi^I \\ A\,\frac{\sigma-1}{\sigma}\,\left(1+\tau_I^{1-\sigma}\right)\,\varphi_i + f + f_I & \text{if } \varphi^I \leq \varphi_i < \varphi^D \\ A\,\frac{\sigma-1}{\sigma}\,\left(1+\tau_D^{1-\sigma}\right)\,\varphi_i + f + f_D & \text{if } \varphi^D \leq \varphi_i \end{cases} \tag{4.13}$$

which is a strictly increasing function of firm productivity φ_i under the assumptions made on the fixed and variable trade costs.

[3] A positive relationship between firm productivity or firm size and the number of export destinations is documented by Bernard et al. (2009) and Eaton et al. (2008), for instance.

[4] Usually, firm productivity is interpreted as the residual that results from fitting a specific production function. A simultaneity problem arises because a firm may observe its productivity and change its factor inputs. Panel data methods to deal with this issue have been suggested by Olley and Pakes (1996) and Levinsohn and Petrin (2003), who use lagged investment or intermediate inputs as proxies, respectively.

There is also strong empirical evidence for the positive relationship between firm size as measured by employment and firm productivity that arises in heterogeneous firm models of international trade. Ark and Monnikhof (1996) show this relationship for France, Germany, Japan, the United States and the United Kingdom. Leung et al. (2008) and Baldwin et al. (2002) add evidence on the positive relationship between employment and productivity for Canada, and Biesebroeck (2005) documents it for a variety of African countries.Snodgrass and Biggs (1995) also find a large productivity gap between the largest and the smallest manufacturing firms in Turkey.

I am now ready to formulate the main hypothesis on the relationship between firm size and the choice of export mode as reflected by the share of indirect exports in total exports.

Hypothesis 4.1 *There is a negative relationship between firm size and the share of indirect export sales in total export sales.*

Apart from size, other firm characteristics are likely to influence the choice of export mode. The age of the firm may play a role, as hypothesized by the international business literature (e.g. Bilkey and Tesar, 1977 or Bilkey, 1978). Young firms start out as purely domestic firms, and once they are established on the national market, they start to export indirectly. After having made first experiences in the foreign market, they begin to export also directly. Thus, I expect a negative impact of firm age on the share of indirect exports in total exports.

Hypothesis 4.2 *There is a negative relationship between firm age and the share of indirect export sales in total export sales.*

Further, Anderson and Gatignon (1986) argue that firms which invest in new technologies and offer innovative and sophisticated products prefer a higher level of control over their foreign activities and therefore rather chose the direct export mode. If they would use a trade intermediary, which has to be trained an equipped with the technological know how that is necessary to sell the product, they would risk losing their competitive advantage. From this I hypothesize that a higher degree of innovation is associated with a lower share of indirect exports in total exports.

Hypothesis 4.3 *There is a negative relationship between firm innovativeness and the share of indirect export sales in total export sales.*

And finally, as the enforceability of international contracts improves, the hold-up problem associated with using a trade intermediary becomes less severe, making indirect exports more attractive (Felbermayr and Jung, 2009). Thus, there is most likely a positive relationship between the level of contract enforceability and the share of indirect exports in total exports.

Hypothesis 4.4 *There is a positive relationship between contract enforceability and the share of indirect export sales in total export sales.*

4.4 Data and descriptive statistics

This study uses data from the Business Environment and Enterprise Performance Survey carried out by the World Bank in cooperation with the European Bank for Reconstruction and Development in Turkey in 2008. Similar surveys have been conducted elsewhere, in particular in a variety of Eastern European and Central Asian countries. Compared to Turkey, however, sample sizes in these countries are very small and the results are presumably not as reliable. Yet, as a simple robustness check, I will extend the analysis to firms in these countries, controlling for country fixed effects. All data is freely accessible to researchers[5] and comprises rich information on stratified random samples of firms with different sizes from different sectors and geographic regions.

As manufacturing firms are the focus of the theoretical literature on firm size and intermediated trade, I exclude those firms from the Turkish sample that are in the service, telecommunication or construction sector.[6] This leaves me with 748 firms for which I have observations on the main variables of interest.

To give a first impression on the relationship between firm size and the relative importance of different export modes, table 4.1 assigns the 748 firms to different size categories according to the number of full-time employees and indicates the percentage of firms within each size category which do not export at all and serve only the domestic market, which export exclusively via trade intermediaries, which use both the indirect and the direct export channel, and which ship their goods only directly. About 39% of the 748 manufacturers sell all their goods nationally and do not export at all. Approximately 12% of all firms in the sample export only via trade intermediaries, while 17% export both indirectly and directly, and 31% export only directly. The share of non-exporters is considerably higher among small firms with less than 20 employees, and is much lower among large firms with 100 or more employees. The reverse is true for the share of direct exporters. While it is only 23% among small firms, it is 49% and 69% among medium sized and large firms, respectively. This finding is in line with what is now considered a fact in the empirical literature on firms in international trade, namely that in a cross-section of firms, exporters are generally larger than non-exporters.[7] Similarly,

[5] http://www.enterprisesurveys.org

[6] The remaining sectors are food (15), textiles (17), garments (18), chemicals (24), plastics and rubber (25), non-metallic mineral products (26), basic metals (27), fabricated metal products (28), machinery and equipment (29), and electronics (31 and 32), with the number in parentheses indicating the Rev. 3.1 International Standard Industrial Classification code.

[7] See for instance Bernard and Jensen (1995) or Bernard et al. (2007).

the share of indirect exporters rises from 19% to 38% when moving from the small to the large firm category.

Table 4.1: Export status and firm size

	Firm size measured by employees			
Export status	< 20	$20 - 99$	≥ 100	Total
No exports	65%	39%	18%	39%
Indirect exports only	11%	12%	13%	12%
Indirect and direct exports	8%	17%	25%	17%
Direct exports only	15%	32%	44%	31%
Total	100%	100%	100%	100%
Number of firms	201	309	238	748

Comparing the prevalence of different export modes across different firm size categories suggests that as firms get larger, they shift from non-exporters to indirect exporters, and further from indirect exporters to direct exporters. The relative prevalence of firms which use an indirect export channel as opposed to firms which do not export at all increases with firm size. However, the relative prevalence of firms which use a trade intermediary as opposed to firms which export only directly declines as firms get larger.

Summary statistics for the 453 firms which export either indirectly or directly or both are given in table 4.2. All information refers to the fiscal year 2007. Firms were asked to indicate their total annual sales in local currency and to report the percentage of total annual sales that were national sales, indirect exports, which were specified as goods sold domestically to a third party that exports them, and direct exports. With this information I can construct the measure S_i. The share of indirect exports in total exports is 0.335 on average and varies considerably across exporters.[8] Firm size as the main explanatory variable is measured by the number of full-time employees. The distribution of firm size is skewed to the right, with a mean of 186 and a median of 70 employees.

In addition to firm size, a variety of other firm characteristics may have an impact on the export behavior and need to be taken into account in the empirical analysis in order to avoid that their effect on the share of indirect exports in total exports is wrongly assigned to the effect of firm size.[9] Firm age indicates the years that have passed since the establishment began its operations and thus captures whether the firm is new to

[8]Unfortunately, total annual sales are not available for all firms in the sample. However, as I am mainly interested in the relative prevalence of intermediated trade as opposed to direct exports, I keep firms with missing information on total annual sales in the sample, as long as they report an estimate of the percentage of total annual sales that were due to indirect and direct exports, respectively. Excluding these firms from the sample and taking sales as a proxy for firm productivity does however not change the main conclusions.

[9]For an overview of the variables that are commonly used to explain the export behavior of firms see Bernard and Jensen (2004), Wagner (2001), and Fryges (2007), for instance.

Table 4.2: Summary statistics

Variable	Mean	(Std. Dev.)	Min.	Max.	N
S_i	0.335	(0.415)	0	1	453
Ln(sales)	16.087	(1.615)	9.393	20.34	390
Firm size	186.139	(377.211)	2	4263	453
Firm age	18	(11.864)	0	82	453
Experience	23.834	(12.313)	1	70	453
Multiplant	0.11	(0.314)	0	1	453
Share university	0.138	(0.16)	0	0.9	453
Share nonproduction	0.25	(0.172)	0	0.842	453
R&D	0.347	(0.476)	0	1	453
New product	0.523	(0.5)	0	1	453
Courts	1.06	(1.294)	0	4	453
Days to clear customs	5.38	(6.815)	0	60	345
Losses in direct exports	1.169	(7.382)	0	100	337

the market, while experience describes the years the top manager has worked in the respective sector. Multiplant is a dummy variable that equals 1 if the firm is part of a larger company. If this is the case, however, all information given in the survey refers to the firm, and not to the larger company. Share university indicates the fraction of employees that have a university degree and hence is a measure for skill intensity, while share nonproduction indicates the fraction of employees that do not work in production, but in areas such as management, administration, sales, or research and development. Both R&D and new product are dummy variables that equal 1 if the firm invested in research and development in 2007 or introduced a new product in the past three years, respectively. These variables reflect firm innovativeness. The variable courts indicates whether firms perceive courts to be an obstacle to their current operations. Answers are integers ranging from 0 (no obstacle) to 4 (very severe obstacle). Courts is used as a proxy for the enforceability of contracts. Some variables of interest are defined only for a subset of firms. The average number of days to clear customs is relevant only for direct exporters, as well as the losses in direct exports, which measure the percentage of consignment value of the products exported directly that was lost while in transit because of theft, breakage or spoilage. These variables may be seen as indicators for the variable costs of shipping goods directly to final consumers.

Table 4.3: Share of indirect exports in total exports and firm size

	Firm size measured by employees		
	< 20	$20 - 100$	≥ 100
Indirect exports/total exports (S_i)	0.44	0.33	0.31

Sorting exporters into different size categories as in table 4.1 and looking at the average share of indirect exports in total exports sheds first light on the relative importance of

intermediated as opposed to direct trade. It seems that indirect exports are indeed less important for larger firms. However, to gain deeper insight into the determinants of the choice of export mode, I will now turn to a multivariate analysis.

4.5 Empirical results

To assess the correlation between firm size and the relative importance of intermediated exports, I will first estimate simple equations of the form

$$S_i = \beta_0 + \beta_1 \ln(\text{firm size}_i) + \beta_2 X_i + \epsilon_i \tag{4.14}$$

where S_i is the share of indirect exports in total exports of firm i, X_i is a vector of control variables, and ϵ_i is an error term. Nearly all estimations include sector and region dummies.[10] The econometric method used will be simple ordinary least squares regressions with heteroskedasticity robust standard errors.[11] Results are presented in columns (1) to (3) of table 4.4.

Column (1) of table 4.4 shows the estimated coefficient of log firm size from a naive regression without further control variables. It is negative and significant, which is consistent with the hypothesis that larger firms have a lower share of indirect exports in total exports. However, firm size is correlated with a set of other firm characteristics which may affect the relative importance of indirect exports. For instance, larger firms are more likely to be part of a larger company, and they have a lower share of non-production employees, reflecting economies of scale in headquarter services.[12] Including such firm characteristics, but omitting firm size in column (2) of table 4.4 shows that being part of a larger company is associated with a significantly higher share of indirect exports in total exports. A firm's degree of innovation as measured by the variables share nonproduction, R&D and new product, on the contrary, has a negative impact on the relative prevalence of intermediated exports. Hence, controlling for these additional firm characteristics is important to estimate the true relationship between firm size and the share of indirect exports in total exports.

In fact, as reported in column (3) of table 4.4, the negative relationship between firm size and the relative importance of intermediated exports is reinforced once other firm characteristics are controlled for. The estimated coefficient of log firm size falls from -0.028 to -0.050 and gets highly significant. It implies that for the smallest firm with only two employees, one more worker is associated with a decline in the share of indirect

[10] For the purpose of the survey, Turkish provinces have been aggregated into five regions, which are Marmara, Aegean, Black Sea and Eastern Turkey, Central Anatolia, and South Turkey.

[11] A Breusch-Pagan test rejects the hypotheses of constant variance.

[12] The correlation coefficient is 0.205 for firm size and multiplant, and -0.125 for firm size and share nonproduction.

exports in total exports by about -0.025. The sign and the size of the coefficient of log firm size are very robust to the inclusion of further firm characteristics, such as the legal status of the firm or the share of the firm that is owned by foreign investors. As these control variables turned out to be insignificant, however, I omitted them from the set of regressors. The results are also insensitive to the use of different functional forms of firm size.[13]

Table 4.4: Effect of firm size on S_i

	(1) OLS	(2) OLS	(3) OLS	(4) QMLE
Ln(firm size)	-0.028*		-0.050***	-0.054***
	(0.015)		(0.017)	(0.018)
Firm age		-0.002	-0.001	-0.001
		(0.002)	(0.002)	(0.002)
Experience		0.000	-0.000	-0.000
		(0.002)	(0.002)	(0.002)
Multiplant		0.161**	0.199***	0.223***
		(0.065)	(0.065)	(0.070)
Share university		0.008	0.068	0.069
		(0.122)	(0.121)	(0.136)
Share nonproduction		-0.183	-0.274**	-0.294**
		(0.131)	(0.134)	(0.145)
R&D		-0.025	-0.017	-0.016
		(0.042)	(0.041)	(0.044)
New product		-0.093**	-0.093**	-0.098**
		(0.043)	(0.043)	(0.044)
Courts		0.028*	0.025	0.026
		(0.016)	(0.016)	(0.016)
Sector dummies	no	yes	yes	yes
Region dummies	no	yes	yes	yes
Constant	yes	yes	yes	yes
N	453	453	453	453
R^2	0.008	0.093	0.110	-

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

As pointed out in the introduction, I cannot control for the number of destination countries, nor for the characteristics of specific foreign markets. Part of this effect may be captured by the sector dummies, which indicate the comparative advantage of an industry compared to potential trading partners, and by the region dummies, which reflect the proximity of the firm to a specific destination country. Nevertheless, if larger firms use a trade intermediary to export to less accessible countries which are not served

[13] See the appendix for the results of these alternative specifications.

by smaller firms, the estimated coefficient is a rather conservative indicator for the negative relationship between firm size and the share of indirect exports in total exports to a given destination country. In other words, if I could run a separate regression for each destination country, I would presumably find a coefficient of firm size that is much larger in absolute terms.

Neither firm age nor the experience of the manager seem to play an important role for the choice of export mode. This might not be surprising, as both are very crude proxies for the experience of a manufacturer in a given destination country. As an alternative measure for foreign experience I used the years that have passed since the firm first exported. However, this variable is available only for a small subset of exporters. It turned out to have no significant effect on the share of indirect exports in total exports, neither did it change the coefficient of log firm size.

Being part of a larger company, as indicated by the multiplant variable, has a significantly positive effect on exporting indirectly as opposed to exporting directly. A potential explanation might be that firms which are part of a larger company mainly sell intermediate inputs and unfinished goods to related firms, but ship relatively less products directly to final consumers.

The fraction of employees that have a university degree per se does not seem to play an important role for the choice of export mode, although part of the effect of a high skilled labor force might be captured by the fraction of employees that work in areas other than production. However, investing in research and development and launching new products has a negative effect on the relative prevalence of intermediated trade. Both variables are jointly significant with a p-value of 0.056. This is in line with the hypothesis that innovative firms prefer a higher level of control regarding their foreign sales mode.

The variable courts which is supposed to capture the legal environment and the enforceability of contracts does not have the expected sign, nor is it significant. Firms were asked not only whether they perceive courts as an obstacle to their operations, but also whether they perceive the legal system as fair, impartial and uncorrupted, whether they think that the court system is quick, and whether they believe that the court system is able to enforce its decisions. None of these alternative measures had a significant impact on the share of intermediated exports in total exports. This may be due to the fact that these measures are highly subjective, and potentially endogenous to the choice of export mode. That is, a firm that frequently contracts with a trade intermediary is more likely to end up in a dispute, and may then perceive dealing with courts as a hindrance to its current operations. In addition, agreements between the exporter and the intermediary may be subject to the legal system in the importing country, in which case courts would not have any informative value for the actual enforceability of contracts.

Some researchers have raised concerns about using ordinary least squares regressions if the dependent variable is a proportion that, by definition, can only take values from 0 to 1. Wagner (2001) has argued that this problem may be especially severe if there are many limit observations, as in the case of the export to sales ratio, but also in the present case where the dependent variable is indirect exports over total exports. Basically, because the dependent variable is bounded between 0 and 1, the effect of any explanatory variable cannot be constant throughout its range. Including non-linear functions of the explanatory variable such as log firm size partly alleviates the problem, however, the predicted values from an ordinary least squares regression can never be guaranteed to lie in the interval $[0, 1]$. Papke and Wooldridge (1996) suggest a non-linear quasi-maximum likelihood estimator (QMLE) that yields consistent and asymptotically normal distributed estimates regardless of the distribution of the dependent variable conditional on the controls, and that leads to predicted values between 0 and 1. The results from applying the fractional response model to the relationship between firm size and the relative importance of indirect exports are presented in column (4) of table 4.4. Note that the reported numbers are marginal effects, which depend on the specific likelihood function and thus differ from the estimated coefficients.

The marginal effect of log firm size on the share of indirect exports in total exports is -0.054 and thus very similar to the marginal effect obtained from an ordinary least squares regression. Log firm size remains significant at the 1% level. The sign and the significance of the marginal effects of other explanatory variables do not change much either, indicating that the results are insensitive to the econometric method used.

In table 4.5, I reduce the sample to those exporters that ship at least part of their goods directly to evaluate the impact of customs clearance procedures and transport risks on the choice of export mode. As I lose all observations for which $S_i = 1$, it is not surprising that the negative relationship between firm size and the relative prevalence of indirect exports gets weaker and insignificant. In fact, finding no large and significant effect of firm size once I restrict the sample to direct exporters suggests that large firms which enter into additional countries and use both the direct and the indirect export mode do not drive the main results. Most explanatory variables lose their predictive power, indicating that the firms which use only the indirect export mode are indeed very different from the firms which also use the direct export mode. The main point, however, is that the higher the losses in the transit of direct exports due to theft, breakage, and spoilage, the higher the relative share of indirect exports.[14] Of course, higher transport costs affect not only the direct exporters, but also the trade intermediaries that ship the goods on behalf of the manufacturers, and to the extent that the trade intermediaries forward theses costs to their suppliers, higher losses would also raise the variable costs of exporting indirectly. Yet, trade intermediaries usually ship the goods of more than one manufacturer and thus can pool the risks of suffering losses in the transit of

[14]This result is robust to removing outliers who lost 100% of their shipments in transit.

goods, implying that indirect exports get relatively more attractive when the risk of high transport costs becomes larger. In that sense, the finding that higher losses in direct exports increase the relative prevalence of indirect exports is in line with the argument that trade intermediaries perform an important role in mitigating the risks associated with engaging in foreign markets (Spulber, 1998).

Table 4.5: The effect of export risk on S_i

	(1) OLS	(2) OLS
Ln(firm size)	-0.004	-0.003
	(0.013)	(0.013)
Firm age	0.001	0.000
	(0.001)	(0.001)
Experience	0.002	0.002
	(0.001)	(0.001)
Multiplant	0.095	0.096
	(0.061)	(0.061)
Share university	-0.097	-0.133
	(0.088)	(0.096)
Share nonproduction	-0.134	-0.123
	(0.097)	(0.099)
R&D	-0.050	-0.056*
	(0.031)	(0.032)
New product	0.007	0.005
	(0.033)	(0.033)
Courts	-0.009	-0.011
	(0.011)	(0.011)
Days to clear customs		-0.001
		(0.002)
Losses in direct exports		0.003*
		(0.002)
Sector dummies	yes	yes
Region dummies	yes	yes
Constant	yes	yes
N	329	329
R^2	0.079	0.087

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.6 Robustness checks

In this section, I will perform a number of robustness checks. First, I will extend the analysis on the relationship between firm size and the relative importance of intermediated trade to a larger sample of Eastern European and Central Asian countries. Second, I will use the log of sales as an alternative measure of firm size. In addition, I will used lagged employment as a measure of firm size, and I will control for total factor productivity to substantiate the claim that firm size is an adequate proxy for firm productivity.

The enlarged sample contains firms from thirty Eastern European and Central Asian countries, including Turkey. As I have already pointed out, sample sizes in these countries are comparatively small and do in many cases not comprise more than fifty exporters. Pooling firms from all countries, and controlling for country fixed effects yields the results presented in table 4.6.[15] As indicated in column (1), the relationship between firm size and the share of indirect exports in total exports is again negative and highly significant. It remains significant but gets much smaller in absolute terms if I restrict the sample to firms with $S_i < 1$, as shown in columns (2) and (3) of table 4.6. Quantitatively, the marginal effects of firm size are in the range of the marginal effects reported in columns (1) and (2) of table 4.5, but the larger sample of direct exporters allows for more precision and lower standard errors.

The results for sales as an alternative measure of firm size are reported in column (1) of table 4.7. Firm size has still a negative and highly significant effect on the prevalence of intermediated exports as opposed to direct exports. The sign and significance of the coefficients estimated for other control variables are also in line with the results reported in column (3) of table 4.4.

Further, as indicated in column (2) of table 4.7, using the number of full-time employees in 2004 rather than in 2007 as a measure of firm size yields very similar results. Firms that are larger in 2004 have a lower share of indirect exports in total exports in 2007. This suggests that causality may in fact run from firm size to the relative prevalence of intermediated trade, unless firms anticipate their export activities already three years in advance and adopt their production capacities. The finding is also consistent with other results from the empirical trade literature which show that high productivity precedes entry into export markets, substantiating the theory of fixed entry costs.[16]

As a last robustness check, I use total factor productivity to test the stylized model presented in section 4.3 in a more direct way. To estimate total factor productivity at the firm level, I regress for each sector separately the log of value added on the log of employment and the log of the value of capital used in production, that is land and

[15] Excluding Turkish firms from the enlarged sample gives the same picture, indicating that results are not driven by country specific characteristics.

[16] See Clerides et al. (1998), Bernard and Jensen (1999), or Aw et al. (2000), just to give a few examples.

Table 4.6: Estimations for Eastern Europe and Central Asia

	(1) OLS	(2) OLS	(3) OLS
Ln(firm size)	-0.038***	-0.011**	-0.011**
	(0.009)	(0.005)	(0.005)
Firm age	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Experience	-0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)
Multiplant	0.054	0.014	0.015
	(0.044)	(0.023)	(0.023)
Share university	-0.007	-0.052	-0.058
	(0.045)	(0.037)	(0.037)
Share nonproduction	-0.214***	-0.069	-0.065
	(0.050)	(0.041)	(0.041)
R&D	0.019	0.001	0.000
	(0.018)	(0.017)	(0.018)
New product	-0.047**	0.024**	0.025**
	(0.022)	(0.011)	(0.012)
Courts	0.003	-0.001	-0.001
	(0.009)	(0.005)	(0.006)
Days to clear customs			0.000
			(0.001)
Losses in direct exports			0.002***
			(0.001)
Sector dummies	yes	yes	yes
Country dummies	yes	yes	yes
Constant	yes	yes	yes
N	1702	1190	1190
R^2	0.090	0.073	0.074

Country clustered standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4.7: Robustness checks

	(1) OLS	(2) OLS	(3) OLS
Ln(sales)	-0.039***		
	(0.014)		
Ln(firm size in 2004)		-0.037**	
		(0.018)	
Total factor productivity			-0.000***
			(0.000)
Firm age	-0.001	-0.000	-0.002
	(0.002)	(0.002)	(0.002)
Experience	-0.001	0.001	-0.001
	(0.002)	(0.002)	(0.002)
Multiplant	0.217***	0.149**	0.156*
	(0.069)	(0.069)	(0.080)
Share university	0.060	0.092	0.234
	(0.125)	(0.137)	(0.207)
Share nonproduction	-0.095	-0.319**	-0.078
	(0.146)	(0.149)	(0.213)
R&D	0.005	-0.041	-0.080
	(0.045)	(0.046)	(0.058)
New product	-0.090*	-0.102**	-0.079
	(0.047)	(0.048)	(0.062)
Courts	0.018	0.027	0.010
	(0.017)	(0.018)	(0.024)
Sector dummies	yes	yes	yes
Region dummies	yes	yes	yes
Constant	yes	yes	yes
N	390	378	232
R^2	0.124	0.118	0.146

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

machinery. I then compute the exponential of the residuals of the estimated equation. As I have already pointed out, this method is most likely plagued by simultaneity problems, and hence estimates of total factor productivity might be seriously flawed. In addition, as I have only a very limited sample of firms in each sector that provided the information necessary to estimate total factor productivity, the precision of the estimation is rather low. The results presented in column (3) of table 7 should therefore be interpreted with caution. What is remarkable, however, is that firm productivity enters negatively, as hypothesized, and is highly significant.

4.7 Conclusion

Although trade intermediation is a phenomenon well established in reality, it has only recently been addressed in the international trade literature. While many contributions focus on the nature of trade intermediaries, little is known about the manufacturers that actually ship their goods indirectly. Recent theoretical research suggests that the choice of export mode depends, among other factors, on the size and the productivity of a firm. Since intermediated exports are associated with lower fixed costs of gaining access to foreign markets, they are an attractive option for small and rather inefficient firms which want to export their goods. Building an own distribution network and maintaining customer relations abroad is much more costly, and only pays for large manufacturers which are profitable enough to cover the higher fixed costs.

The present paper brings this hypothesis to a test. Using data from the World Bank Enterprise Survey conducted in Turkey in 2008, it shows that there is indeed a significant negative correlation between firm size and the relative importance of indirect exports as opposed to direct exports. This relationship is robust to the inclusion of a variety of controls, different estimation methods, and different measures of firms size.

One drawback of the data used is that is does not contain any information on the number and the features of the destination countries a firm serves. This seems to be a more general problem in the empirical international trade literature. Transaction based data sets as provided by customs authorities have information on destination countries, however they rarely provide details on the firms involved in intermediated trade. Rich information about firm characteristics from the analysis of balance sheet data or survey data does however rarely comprise details about firms' export destinations. Combining both destination country and firm characteristics in a large sample seems to be a promising avenue for further research on the role of indirect exports for different manufacturers. Another way to improve upon the existing evidence is to use rigorous measures of firm productivity estimated from panel data instead of proxies for firm size such as employment or sales.

From a theoretical perspective, modeling a trade intermediation sector instead of simply assuming a specific intermediation technology would be the next step. First attempts in this direction have been made by Antràs and Costinot (2010a) and Antràs and Costinot (2010b).

Appendix

Appendix A: Results for alternative specifications

Including additional controls for the legal status of a firm and the percentage of a firm owned by foreign investors gives the results presented in columns (1) and (2) of table 4.8. Using firm size instead of log firm size or firm size and firm size squared gives the results indicated in columns (3) and (4) of table 4.8. Note that in column (4), firm size and firm size squared are jointly significant at the 5% level.

Table 4.8: Effect of firm size on S_i for alternative specifications

	(1) OLS	(2) OLS	(3) OLS	(4) OLS
Ln(firm size)	-0.049***	-0.049***		
	(0.017)	(0.017)		
Firm size			-0.000**	-0.000
			(0.000)	(0.000)
Firm size squared				-0.000
				(0.000)
Firm age	-0.002	-0.001	-0.002	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)
Experience	0.000	-0.001	0.000	0.000
	(0.002)	(0.002)	(0.002)	(0.002)
Multiplant	0.205***	0.212***	0.178***	0.178***
	(0.066)	(0.065)	(0.066)	(0.066)
Share university	0.031	0.080	0.021	0.020
	(0.125)	(0.123)	(0.122)	(0.122)
Share nonproduction	-0.284**	-0.247*	-0.222*	-0.220
	(0.134)	(0.135)	(0.134)	(0.135)
R&D	-0.016	-0.008	-0.022	-0.022
	(0.042)	(0.042)	(0.042)	(0.042)
New product	-0.097**	-0.104**	-0.091**	-0.091**
	(0.043)	(0.043)	(0.043)	(0.043)
Courts	0.026	0.027*	0.027*	0.027*
	(0.016)	(0.016)	(0.016)	(0.016)
Foreign ownership		-0.001		
		(0.001)		
Legal status dummies	yes	no	no	no
Sector dummies	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes
Constant	yes	yes	yes	yes
N	453	449	453	453
R^2	0.122	0.115	0.098	0.098

Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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Eidesstattliche Erklärung

Hiermit erkläre ich, dass ich die Dissertation selbstständig angefertigt und mich anderer als der in ihr angegebenen Hilfsmittel nicht bedient habe, insbesondere, dass aus anderen Schriften Entlehnungen, soweit sie in der Dissertation nicht ausdrücklich als solche gekennzeichnet und mit Quellenangaben versehen sind, nicht stattgefunden haben.

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