Department of Economics

Three Essays on International Trade

Sarah Stölting

Thesis submitted for assessment with a view to obtaining the degree of
Doctor of Economics of the European University Institute

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Introduction

The three chapters included in this thesis all touch upon very different aspects of the disciplines of international trade and economics. The first chapter shows that trade liberalization can lead to a permanent increase in growth rates in a model of selection and imitation. The second chapter takes a very different approach to gains from trade, and demonstrates that trade liberalization can be a potentially effective tool for curbing corruption. The third chapter is more policy oriented, and motivated by the recent explosion in the number of both North-North and South-South regional preferential trade agreements.

More specifically, the first chapter analyzes the impact of trade liberalization on productivity growth through industry dynamics. It develops an endogenous growth model with heterogeneous firms to analyze the impact of intra-industry trade on productivity growth. Growth is generated by selection, and sustained by entrants imitating successful incumbents. Firms are subject to idiosyncratic productivity shocks and some firms, mostly those with relatively low productivity levels, are forced to exit. This results in an increase in average productivity of the economy. The intra-industry effect of trade works through self-selection of the most productive firms into the export market. It leads to a reallocation of resources towards more efficient firms. In the open economy, each firm has a higher probability to be hit by a bad shock which forces it out of the market than in the closed economy. Since this additional trade-induced selection process amplifies the effect of selection, opening up to trade increases the growth rate of productivity.

The second chapter is joint work with Oskar Nelvin, and is focussed on the implications of trade on a political economy dimension, namely corruption. We identify a channel through which trade opening can affect bureaucratic corruption. We further argue that trade liberalization can be a potentially potent tool in the fight against corruption. Trade

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opening leads to tougher competition and consequently reduces the official's ability to extract rents from firms. The overall bribe level of the economy is thereby reduced. In addition, as corruption distorts entry decisions and harms welfare, trade liberalization has a stronger welfare enhancing effect under corruption than in a bribe free economy. We further analyze the incentive for governments to fight corruption, and find that the incentives are stronger when trade costs are lower. Finally, we empirically test the main prediction of the model and find that more remote and less easily accessible countries also suffer from higher levels of corruption.

The third chapter, which is again joint work with Oskar Nelvin, departing from the previous issues, is a policy oriented case study. It seeks to analyze the impact on intra- and interregional trade flows stemming from the first wave of tariff reductions under the South Asian Free Trade Agreement (SAFTA). Most pre-treaty implementation studies put into question the treaty's potential of intraregional trade creation. However, our estimates, conducted on post treaty implementation data, indicate a very strong trade creating effect; for eligible product categories, intra regional trade flows are estimated to have increased by as much as 40% on average. This figure is substantially higher than estimates for other trade blocks. Further, trade diversion appears to have been limited, or nonexistent, though this is due mainly to the treaty being accompanied by significant reductions in external tariffs.

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Chapter 1

International Trade and Growth: The Impact of Selection and Imitation

1.1 Introduction

This chapter analyzes the impact on productivity growth of opening up an economy to costly trade. For this purpose an endogenous growth model with heterogeneous firms and intra industry-trade is developed. Growth is driven by a mechanism of selection and sustained by entrants imitating successful incumbents. International trade makes selection tougher, and leads thus to a permanent increase in the productivity growth rate.

In recent years there have been an increasing number of empirical and theoretical research papers analyzing the effects of trade on productivity. Bernard and Jensen (1995) published one of the first papers using firm-level data to investigate productivity differences between exporting and non-exporting firms. Since then, there has been a number of papers based on firm-level data from different countries. The two most important results of these studies are the following: First, there are large differences within industries in the export behavior of firms. Even in the so-called export-sectors, a large part of firms sell their products only in the domestic market. Secondly, exporting firms have higher performance characteristics than non-exporting firms, i.e. their productivity tends to be significantly higher, they are

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lager, more capital intensive and pay higher wages. The question of causality, i.e. whether more efficient firms become exporters or whether firms improve their performance after entering the export market, has been addressed by Bernard and Jensen (1999). They find clear evidence for more efficient firms becoming exporters, since performance measures are higher ex-ante for exporters. These differences, related to the export status among firms within industries, suggest that there is a self-selection of more productive firms into export markets.

Both 'old' trade theory and 'new' trade theory fail to consider firm level differences within sectors. New models have been developed in the last years in order to take into account intra-industry heterogeneity in terms of productivity. One important contribution is the model developed by Melitz (2003) where opening up to costly trade leads to an increase in productivity by reallocating resources to more efficient firms, i.e. through a mechanism of selection. However, the approach in Melitz (2003) assumes zero-growth in the steady state. There have been very few papers which introduce growth in this framework, among them Baldwin and Robert-Nicoud (2008) and Gustafsson and Segerstrom (2006). In both papers endogenous growth is generated by innovation, and trade liberalization leads to an increase in productivity growth.

On the empirical side the effect of trade on growth is more ambiguous.[1] While some papers find that the relationship is positive (mostly without being able to establish causality due to endogeneity problems), other papers find no significant correlation. On the other hand, as mentioned above, there is very clear and strong evidence for self-selection of highly productive firms into the export market. This mechanism of self-selection leads to a reallocation of resources from low-productivity to high-productivity firms. Reallocation of resources can be of great importance to the evolution of productivity growth.[2]

Despite the fact that there is clear evidence for selection playing an important role in explaining economic growth, the growth literature based on selection is quite limited. Gabler and Licandro (2007) and Luttmer (2007) are among the first ones to provide models

[1]Lopez (2005) and Berg and Krueger (2003) provide surveys on empirical studies analyzing whether trade has a positive impact on the growth rate of the economy, and they show that there is a large divergence in the evidence.

[2]For example, Pavcnik (2002) shows that about one third of aggregate productivity growth of Chilean plants over the period 1979 to 1986 can be explained by this type of reallocation of resources. Similarly, Bernard and Jensen (2004a) find that about 40% of total factor productivity growth can be attributed to a redistribution of resources across firms in the US manufacturing sector during the late 80s and early 90s.

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of endogenous growth through selection of successful firms and imitation by entrants based on rational expectations. Both papers find that a significant part of output growth can be attributed to selection and imitation.

The aim of this chapter is to analyze how trade affects growth through the specific channel of selection. For this purpose a model of endogenous growth with intra-industry trade and firm heterogeneity is developed. Endogenous growth is generated by idiosyncratic firm productivity improvements, selection of existing firms and imitation of surviving firms by entrants, as in Gabler and Licandro (2007) and Poschke (2007). Concerning the trade component, the model is based on Melitz (2003). Hence, in this model, both the mechanism through which the economy is affected by opening up to costly trade and the mechanism generating growth work through a channel of selection, i.e. high productivity firms expand their market share and low-productivity firms either loose market share or exit the market. Moving from a closed economy to an economy with costly trade makes the growth rate permanently increase, because the effect of selection and imitation on growth is amplified by the selection process that is due to trade.

The following mechanism underlies the result. The existence of fixed costs of production makes it impossible for firms with low productivities to generate positive profits. This implies a cutoff productivity level below which exit is optimal. The idiosyncratic productivity shock hitting incumbent firms is more likely to push firms with already low productivity levels below the cutoff. This means that the average productivity of the whole economy, and also the distribution of incumbents, shift to the right. To ensure that there are always new firms replacing the exiting ones, entry takes place. In order to always have entrants above the cutoff productivity level, the distribution of entrants has to follow the distribution of incumbents in its movement to the right. This is achieved by allowing entrants to imitate imperfectly successful incumbents. Therefore growth is sustainable. If the economy opens up to export possibilities, which are assumed to require a payment of a fixed cost, wages increase, and the least productive firms are forced to exit. Hence, the cutoff productivity level and aggregate productivity increase. The implication of the higher cutoff level is that each remaining firm has now a higher probability to be hit by a bad shock which forces it out of the market. This means that selection is tougher, and hence the average productivity increases at a faster rate than in a closed economy.

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The remaining of the chapter is organized as follows: in Section 1.2 the setup for the closed economy is presented, and in Section 1.3 the model is extended to the open economy case with trade between two symmetric countries. Section 1.4 provides a calibration, numerical solution and results of the model. Section 1.5 concludes.

1.2 Closed Economy

1.2.1 Demand

There is a continuum of households in the economy. Each household lives forever and inelastically supplies labor. The population does not grow, and aggregate labor supply is normalized to one. Preferences of the representative household are given by

$$U = \sum_{t=0}^{\infty} \beta^t ln(C_t),$$

where

$$C_t = \left(\int_{\omega \in \Omega} q_t(\omega)^{\frac{\theta-1}{\theta}} d\omega \right)^{\frac{\theta}{\theta-1}}.$$

Households consume different varieties ω, and the total set of varieties is given by Ω. Different varieties are substitutes, and the elasticity of substitution between any two varieties is given by $\theta > 1$. The discount factor is β, with $\beta \in (0, 1)$. Aggregate expenditure in the economy is given by $E_t = C_t P_t$, where P_t is the aggregate price level:

$$P_t = \left(\int_{\omega \in \Omega} p_t(\omega)^{1-\theta} d\omega \right)^{\frac{1}{1-\theta}}.$$

The static consumers problem is given by maximizing consumption of each variety, taking into account aggregate expenditure. Solving this maximization problem yields the households demand for each variety ω

$$q_t(\omega) = \left(\frac{p_t(\omega)}{P_t} \right)^{-\theta} C_t. \tag{1.1}$$

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Hence, optimal expenditure for variety ω is

$$e_t(\omega) = \left(\frac{p_t(\omega)}{P_t}\right)^{1-\theta} E_t.$$

Households also choose the optimal intertemporal allocation of consumption by maximizing the lifetime utility, taking into account their budget constraint. They can consume or invest in shares of a mutual fund, that pays a return r_t, which is the real interest rate. Firms in the economy generate aggregate profits, and since firms are owned by households, profits are transfered as dividends, allowing consumers to shift consumption over time. This eliminates any liquidity constraints of firms. Solving the dynamic optimization problem yields the standard Euler Equation, which defines the growth rate of consumption

$$g_t \equiv \frac{C_{t+1}}{C_t} = \beta(1 + r_t). \tag{1.2}$$

This implies that the gross real interest rate in the economy is given by $1+r_t = (1+g_t)/\beta$.

1.2.2 Supply

There is a continuum of firms, each choosing to produce a different variety ω. Technology for a firm with productivity φ is given by

$$q_{\omega,t}(\varphi) = \varphi_{\omega,t}(l_{\omega,t} - f^p). \tag{1.3}$$

Marginal costs are constant and f^p is the fixed cost of production. Firms are heterogeneous in their productivity levels φ. Every period each firm receives a shock to its productivity. This idiosyncratic shock follows a random walk

$$ln(\varphi_{\omega,t+1}) = ln(\varphi_{\omega,t}) + \eta_{\omega,t+1}. \tag{1.4}$$

The idiosyncratic productivity shock is assumed to be normally distributed, $\eta_{\omega,t} \sim N(0, \sigma_\eta^2)$, i.e. the expected growth rate of firm specific productivities is zero for each firm. The subscript ω is dropped from now on, because each firm produces a different variety, even if two firms have the same productivity. Firms which have the same φ charge the same

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price, hire the same amount of labor and hence make the same profits, even if they supply different varieties. Profits of a firm in period t are given by:

$$\pi_t(\varphi) = q_t(\varphi)p_t(\varphi) - w_t l_t(\varphi).$$

It follows from the profit maximization problem that a firms with productivity φ will charge a price

$$p_t(\varphi) = \frac{\theta}{\theta - 1}\frac{w_t}{\varphi_t}. \tag{1.5}$$

Plugging the optimal price into the optimal expenditure from the household problem yields the firms revenue:

$$e_t(\varphi) = E_t\left(\frac{\theta - 1}{\theta}\frac{\varphi_t}{w_t}P_t\right)^{\theta-1}. \tag{1.6}$$

It follows that profits can be rewritten as

$$\pi_t(\varphi) = \frac{1}{\theta}e_t(\varphi) - f^p. \tag{1.7}$$

From now on nominal wages are normalized to one, i.e. $w_t = 1$ for all periods.

1.2.3 Firm Entry and Exit

The firm dynamics are based on the model of Hopenhayn (1992). Every existing firm receives an idiosyncratic shock in each period as is specified in equation (1.4). This means that some firms will decide to exit the market because their productivity is lower than a certain threshold φ^*, below which producing would yield a negative firm value. The probability density function of incumbent firms is given by $\mu_t(\varphi)$. No specific distributional form is assumed since it is determined endogenously in equilibrium. The mean and and the variance are denoted by x_t^i and σ_i^2 respectively.

Entering firms have to pay a sunk entry cost f_e, and are less productive on average than incumbent firms even though they try to imitiate successful incumbents. They start with a productivity level which they draw from a log-normal distribution $\gamma_t(\varphi)$ with a mean x_t^e and variance σ_e^2. The imitation process is modeled as in Poschke (2007): The mean of the entrants productivity distribution follows the productivity of the best incumbent, φ_t^{max},

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with a constant distance $\kappa > 0$:

$$x_t^e = \varphi_t^{max} - \kappa, \tag{1.8}$$

where φ_t^{max} is defined as being the average of the best 5 percent of all producing firms. Figure 1.1 provides an graphical illustration of the imitation process.

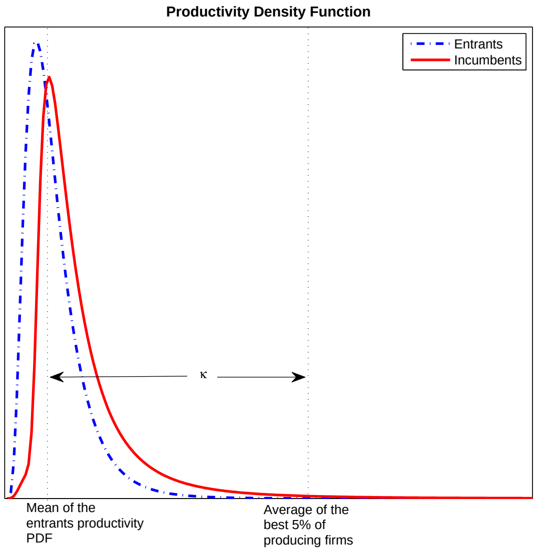

Figure 1.1: Productivity Density and the Imitation Parameter

The timing is defined as follows: A firm takes the decision to exit at the beginning of period t. The relevant threshold for the decision to produce in t is given by φ_t^*. If the decision has been taken to produce in a given period, then an incumbent gets a new productivity draw, pays the fixed costs of production f^p and produces. The entry decision of new firms is also taken at the beginning of period t. If entry occurs, then the entrant has to pay the fixed entry costs f^e, gets its initial productivity draw out of the distribution $\gamma_t(\varphi)$, pays the fixed costs of production f^p and produces. Both fixed costs f^p and f^e, are payed in labor units.[3] See Appendix A for a graphical illustration of the timing assumptions in the economy.

The value function of a firm with productivity level φ is given by

$$V(\varphi) = \max_p \left\{ \pi(\varphi) + \frac{1}{1+r} \max \left\{ \int_0^\infty V(\varphi')\nu^\eta(\varphi'/\varphi)d\varphi', 0 \right\} \right\}, \tag{1.9}$$

[3]Fixed costs here are not constant, but evolve over time. Since they are given in terms of labor, and nominal wages are normalized to one, this means that they are increasing in terms of consumption.

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where ν^η is the probability density function of the exponential of the idiosyncratic productivity shock $e^{\eta_{\omega,t}}$. This means that $\nu^\eta(\varphi'/\varphi)$ is the probability that a firm with productivity φ today receives a shock such that it has a productivity φ' tomorrow.

Free exit: Some firms decide to exit the market because their productivity does not ensure them a positive expected future value. Firms with a productivity level $\varphi_t < \varphi_t^*$ exit the market. The free exit condition is given by:

$$\int_0^\infty V(\varphi')\nu^\eta(\varphi'/\varphi^*)d\varphi' = 0 \tag{1.10}$$

Free entry: A fixed sunk cost f_e has to be payed by each firm which wants to start production. New firms will enter the market until the net value of entering is driven to zero. It follows that the free entry condition is given by

$$V^e = \int_0^\infty V(\varphi)\gamma(\varphi)d\varphi = f^e. \tag{1.11}$$

Transition function: In every period there are incumbent firms with distribution $\mu_t(\varphi)$ and entrants with distribution $\gamma_t(\varphi)$. In the following period the 'new' PDF of incumbents will be the one of the old surviving incumbents (i.e. those firms that have a productivity level higher than the cutoff), plus the new entrants. Hence the transition function for the distribution of incumbent firms is given by

$$N'\mu'(\varphi') = N\int_{\varphi^*}^\infty \nu^\eta(\varphi'/\varphi)\mu(\varphi)d\varphi + N'^e\gamma(\varphi'), \tag{1.12}$$

where N is the number of incumbents, and N^e the number of firms entering the market.

1.2.4 Aggregation

The aggregate productivity level is denoted as $\tilde{\varphi}$. It is also the average productivity weighted by relative output shares and is given by:

$$\tilde{\varphi}_t = \left(\int_0^\infty \varphi^{\theta-1}\mu_t(\varphi)d\varphi\right)^{\frac{1}{\theta-1}}. \tag{1.13}$$

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Using the definition of the aggregate price level given above, the optimal price chosen by firms and the definition of the cutoff level, the aggregate price level can be expressed as

$$P_t = \left(\int_0^\infty p_t(\varphi)^{1-\theta} N_t \mu_t(\varphi) d\varphi \right)^{\frac{1}{1-\theta}} = \frac{\theta}{\theta - 1} N_t^{\frac{1}{1-\theta}} \tilde{\varphi}^{-1}. \tag{1.14}$$

Aggregate output is

$$Q_t = \left(\int_0^\infty q_t(\varphi)^{\frac{\theta-1}{\theta}} N_t \mu_t(\varphi) d\varphi \right)^{\frac{\theta}{\theta-1}} = q(\tilde{\varphi}_t) N_t^{\frac{\theta}{\theta-1}}, \tag{1.15}$$

and aggregate profits are

$$\Pi_t = \int_0^\infty \pi_t(\varphi) N_t \mu_t(\varphi) d\varphi = N_t \pi_t(\tilde{\varphi}_t). \tag{1.16}$$

1.2.5 Equilibrium

The stationary equilibrium is defined as sequences of prices $\{p_t\}_{t=0}^\infty$, $\{P_t\}_{t=0}^\infty$, sequences of real numbers $\{N_t\}_{t=0}^\infty$, $\{N_t^e\}_{t=0}^\infty$, $\{Q_t\}_{t=0}^\infty$, $\{\varphi_t^*\}_{t=0}^\infty$, functions $l(\varphi;\mu)$, $v(\varphi;\mu)$, and sequences of probability density functions $\{\mu_t\}_{t=0}^\infty$, such that:

- **consumers** choose optimally consumption according to (1.1) and asset holdings to satisfy the Euler equation (1.2),
- **firms** set prices optimally according to (1.5), yielding the value function (1.9),
- **exit** is optimal and given by the free exit condition (1.10),
- **entry** is optimal and given by the free entry condition (1.11),
- the **labor market clears**: $L = L_t^p + L_t^e$, where $L_t^p = E_t - \Pi_t$ is the amount of labor used in production and $L_t^e = N_t^e f^e$ the amount of labor used for paying the entry costs,
- the **stationary distribution** of firms $\mu_t(\varphi)$ evolves according to the transition function (1.12).

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1.2.6 Balanced Growth Path

The balanced growth path (BGP) is defined as a state of the economy in which aggregate productivity, consumption and output grow at a constant rate g, aggregate prices decrease at the same constant rate, the distribution of firm productivities shifts up at steps of g, its shape is invariant[4], and aggregate expenditures, aggregate profits, the number of firms, the number of entrants and the interest rate are constant. The economy can then be stationarized, and to distinguish it from the growing economy, stationarized variables are denoted with a hat. The relevant equations for the BGP, i.e. the equations that have to be rewritten in stable terms, are the law of motion of productivity (1.4), the value function (1.9),the transitions function for the distribution of productivities (1.12), the free exit condition (1.10), and the free entry condition (1.11).

The random walk of productivities (1.4) gets a downward drift in the stationarized economy. The distribution shifts to the right every period by a step of size g, but the idiosyncratic productivity shock is such that it has a zero mean, i.e. a firm does not expect its productivity to change. Hence in expectations each firm has a decreasing productivity relative to the overall distribution:

$$ln(\hat{\varphi}_{\omega,t+1}) = ln(\hat{\varphi}_{\omega,t}) - g + \eta_{\omega,t+1}. \tag{1.17}$$

Combining equation (1.7) and (1.6), firm specific profits can be rewritten as

$$\pi(\hat{\varphi}) = \frac{1}{\theta}\left(\frac{\theta-1}{\theta}\right)^{\theta-1}\hat{\varphi}^{\theta-1}k - f^p, \tag{1.18}$$

where $k = EP^{\theta-1}$. Substituting this expression into the value function (1.9), and using the Euler Equation (1.2) yields a stationary expression for the value function of a firm

$$v(\hat{\varphi}) = \pi(\hat{\varphi}) + \frac{\beta}{g}\max\left\{\int_0^\infty v(\hat{\varphi}')\nu^\eta(\hat{\varphi}'/\hat{\varphi})d\hat{\varphi}', 0\right\}. \tag{1.19}$$

[4]Even though the evolution of firm-specific productivities follows a random walk, the distribution of firms is stationary. Its variance remains finite over time since exit takes place mostly in the lower part of the distribution and since the probability of surviving decreases with the age of the firm. For more details see Poschke (2007).

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Applying the same method, the free exit condition (1.10) in the balanced growth path is

$$\int_0^\infty v(\hat{\varphi}')\nu^\eta(\hat{\varphi}'/\hat{\varphi}^*)d\hat{\varphi}' = 0, \tag{1.20}$$

the free entry condition (1.11) is

$$v^e = \int_0^\infty v(\hat{\varphi})\gamma(\hat{\varphi})d\hat{\varphi} = f^e, \tag{1.21}$$

and the transition function (1.12) can be rewritten as

$$\mu(\hat{\varphi}') = \int_{\hat{\varphi}^*}^\infty \nu^\eta(\hat{\varphi}'/\hat{\varphi})\mu(\hat{\varphi})d\hat{\varphi} + \frac{N^e}{N}\gamma(\hat{\varphi}') \tag{1.22}$$

Given these equations (1.17)-(1.22), the balanced growth path of the closed economy can be solved numerically.

1.3 Open Economy

In order to analyze the impact of trade on economic growth, the previous setup is adjusted to an open economy framework. Only trade between two symmetric countries is considered for simplicity. An extension to a larger number of countries trading with each other does not alter the main results.[5] The assumption of symmetry implies that both countries have the same wage, which is normalized to one, and that the aggregate variables of both countries are the same. Another assumption that is made, is that exporting firms face an additional fixed cost f^x for exporting in every period they serve the foreign market, and also variable, iceberg type, trade costs τ. The existence of fixed costs to exporting is crucial. Otherwise the only effect of trade is an increase of consumers welfare due to a rise in the number of varieties available for consumption as in Krugman (1980). There exist several empirical studies which find that firms face fixed costs to enter the export market, for example Bernard and Jensen (2004b) for the US.

On the demand side there are no changes in the setup due to opening up the economy. Consumers still face the same maximization problem subject to the same constraints, which means that the demand for each variety is determined as in the closed economy and

[5]See Melitz (2003) for trade between n number of symmetric countries

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is given by equation (1.1). On the other hand firms now also have to make an additional decision: after receiving their productivity draw firms have to evaluate whether they want to pay the fixed investment to export, or only serve the domestic market.

1.3.1 Supply

The production function is the same as before, and firms that sell only in the domestic market pay the fixed costs f^p, but firms which also enter the export market now pay additionally the fixed cost f^x. The profit function changes because now profits can be generated from local and from foreign sales. Production, prices, the amount of labor used and profits for the local market are denoted by q^d, p^d, l^d, π^d and for the exporting market by by q^x, p^x, l^x, π^x.

$$\pi_t^d(\varphi) = q_t^d(\varphi)p_t^d(\varphi) - l_t^d(\varphi)$$

$$\pi_t^x(\varphi) = q_t^x(\varphi)p_t^x(\varphi) - l_t^x(\varphi)$$

The total amount of labor spent in production by a firm with productivity φ is $l_t(\varphi) = l_t^d(\varphi) + l_t^x(\varphi)$, where $l_t^x = 0$ if the firm sells only in the domestic market.

The price for domestic sales p_t^d is the same as in closed economy and given by equation (1.5), but a firm that exports will set higher prices in the export market because of the per unit trade costs:

$$p_t^x(\varphi) = \tau \left(\frac{\theta}{\theta - 1}\right) \frac{w_t}{\varphi_t}. \tag{1.23}$$

Overall profits of a firm with productivity φ in period t are given by

$$\pi_t(\varphi) = \pi_t^d(\varphi) + \max \left\{0, \pi_t^x(\varphi)\right\}. \tag{1.24}$$

where $\pi_t^d(\varphi_t)$ is given by equation (1.7), and $\pi_t^x(\varphi) = \frac{1}{\theta} e_t^x(\varphi) - f^x$, with $e_t^x(\varphi) = \tau^{1-\theta} e_t^d(\varphi)$.

1.3.2 Firm Entry and Exit

The value function of a firm with productivity φ is given by equation (1.9). Notice that profits that enter the value function are not the same as in closed economy, because they now consist of domestic and export sales. In the open economy there are

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two cutoff levels, one for producing φ_t^* (which is given by equation (1.10)) and one for exporting φ_t^{*x}. The productivity cutoff level for entering the export market is $\varphi_t^{*x} = \inf\{\varphi_t : \varphi_t > \varphi_t^* \text{ and } \pi_t^x(\varphi_t) \geq 0\}$, and can be determined by the following equation:

$$\pi_t^x(\varphi_t^{*x}) = 0. \tag{1.25}$$

The free entry condition is again given by equation (1.11), and the transition function of the distribution of incumbents by equation (1.12).

The timing is the same than in the closed economy, except of the decision to enter the export market. Once the firms, incumbents and entrants, got their productivity draw for a given period, they decide whether to export or not. Entering the export market takes place if $\varphi_t \geq \varphi_t^{*x}$.

1.3.3 Aggregation

Aggregate productivity is as before given by the weighted average productivity, with the weight being relative output shares. It can not be defined in the same way as in the closed economy, because equation (1.13) does not take into account the higher market share of exporting firms. In order to do so, it has to be considered that some firms export, and some firms serve only the domestic market. Hence there are two aggregate productivity levels, $\tilde{\varphi}_t^d$ for all firms (but taking into account only domestic market shares), and $\tilde{\varphi}_t^x$ for exporting firms only (including only exporting market shares):

$$\tilde{\varphi}_t^d = \left(\int_0^\infty \varphi_t^{\theta-1}\mu_t(\varphi_t)d\varphi_t\right)^{\frac{1}{\theta-1}} \qquad \tilde{\varphi}_t^x = \left(\frac{1}{1-M(\varphi_t^{*x})}\int_{\varphi_t^{*x}}^\infty \varphi_t^{\theta-1}\mu_t(\varphi_t)d\varphi_t\right)^{\frac{1}{\theta-1}},$$

where $1-M(\varphi_t^{*x})$ is the ex-ante probability for each firm to draw a productivity level higher than the exporting cutoff. The total aggregate productivity level, which also reflects the relative market shares, is then given by:

$$\tilde{\varphi}_t = \left(\frac{N_t}{N_t+N_t^x}\left(\tilde{\varphi}_t^d\right)^{\theta-1} + \frac{N_t^x}{N_t+N_t^x}\left(\frac{1}{\tau}\tilde{\varphi}_t^x\right)^{\theta-1}\right)^{\frac{1}{\theta-1}}, \tag{1.26}$$

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where N_t^x is the number of firms exporting, or the number of varieties exported to the other country.[6] The variable trade costs τ reflect the output shrinkage linked to exporting. Since every exporting firm is also producing for the domestic market, the total number of firms producing in the economy is N_t. Since additionally to domestic varieties, the consumers also have access to imported varieties, the total mass of different varieties available to a consumer is $N_t + N_t^x$.

The aggregate price level is now given by

$$P_t = \frac{\theta}{\theta - 1}(N_t + N_t^x)^{\frac{1}{1-\theta}}\tilde{\varphi}^{-1},$$

and aggregate profits by

$$\Pi_t = \frac{1}{\theta}E_t - f^p N_t - f^x N_t^x.$$

1.3.4 Equilibrium

The stationary equilibrium is defined as sequences of prices $\{p_t^d\}_{t=0}^{\infty}$, $\{p_t^x\}_{t=0}^{\infty}$, $\{P_t\}_{t=0}^{\infty}$, sequences of real numbers $\{N_t\}_{t=0}^{\infty}$, $\{N_t^e\}_{t=0}^{\infty}$, $\{N_t^x\}_{t=0}^{\infty}$, $\{Q_t\}_{t=0}^{\infty}$, $\{\varphi_t^*\}_{t=0}^{\infty}$, $\{\varphi_t^{*x}\}_{t=0}^{\infty}$, functions $l(\varphi;\mu)$, $v(\varphi;\mu)$, and sequences of probability density functions $\{\mu_t\}_{t=0}^{\infty}$, such that:

- **consumers** choose optimally consumption according to (1.1) and asset holdings to satisfy the Euler equation (1.2),
- **firms** set prices optimally according to (1.5) in the domestic market and (1.23) in the foreign market, yielding the value function (1.9),
- the **export decision** is taken optimally and given by equation (1.25): only firms with $\varphi_t > \varphi_t^{*x}$ export,
- **exit** is optimal and given by the free exit condition (1.10),
- **entry** is optimal and given by the free entry condition (1.11),
- the **labor market clears**: $L = L_t^p + L_t^e$, where $L_t^p = E_t - \Pi_t$ is the amount of labor used in production including the labor needed to pay the fixed costs of exporting

[6]Note that by the assumption of symmetry, this is also equal to the number of varieties imported to the domestic country.

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and $L_t^e = N_t^e f^e$ the amount of labor used for paying the entry costs,

- the **stationary distribution** of firms $\mu_t(\varphi)$ evolves according to the transition function (1.12).

1.3.5 Balanced Growth Path

The balanced growth path is defined in the same way as in the closed economy, except for the expression for profits, now given by (1.24). Rewriting this equation yields:

$$\pi(\hat{\varphi}) = \frac{1}{\theta}\left(\frac{\theta-1}{\theta}\right)^{\theta-1}\hat{\varphi}^{\theta-1}k - f^p + \max\left\{\frac{1}{\theta}\left(\frac{\theta-1}{\theta}\right)^{\theta-1}\tau^{1-\sigma}\hat{\varphi}^{\theta-1}k - f^x, 0\right\}. \quad (1.27)$$

The value function, the free exit and entry conditions and the transition function are still given by equation (1.19), (1.20), (1.21) and (1.22) respectively. Note that profits entering the equations are not the same as in the closed economy. The export decision is taken according to (1.25), and hence:

$$\frac{1}{\theta}\left(\frac{\theta-1}{\theta}\right)^{\theta-1}\tau^{1-\sigma}(\hat{\varphi}^{*x})^{\theta-1}k - f^x = 0. \quad (1.28)$$

Given equations (1.19), (1.20), (1.21), (1.22), (1.27) and (1.28) the balanced growth path can be solved numerically.

1.4 Solution

1.4.1 Calibration

In this section, parameter values for the open economy model are calibrated to the U.S. manufacturing sector in order to derive quantitative conclusions of the selection and imitation mechanism on the growth rate of productivity. The parameters that need to be calibrated are the discount factor β, the elasticity of substitution θ, the fixed costs of production f^p, entry f^e and exporting f^x, the variable exporting cost τ, the variance of the productivity distribution of entrants σ_e^2, the variance of the idiosyncratic productivity shock σ_η^2, and the imitation parameter κ. Common values from the literature are assigned

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to β and θ. All other parameters are jointly chosen by minimizing the distance between some moments observed in the data and the equivalent moment of the model by using a genetic algorithm as described by Dorsey and Mayer (1995).

The moments observed in the data used for the calibration are the following: the proportion of exporters, the size advantage of exporters, the size of entrants relative to incumbents, the seven-year survival rate of entrants, the exit rate, the average firm size and the annual growth rate. The first two observations help to determine the trade costs f_x and τ. The size of entrants relative to incumbents allows me to find the imitation parameter κ, since it establishes a relationship between the distribution of incumbents and entrants. The seven-year survival rate of entrants, the exit rate and the average firm size give some good indications about the firm dynamics and scale, and thus help to calibrate the parameters f^e, f^p and σ_e^2. Finally, the growth rate of output determines the variance of the idiosyncratic productivity shock σ_η^2.

Table 1.1: Calibration results

Calibration	Target (U.S.)	Model
Proportion of exporters	21%	23.85%
Size advantage of exporters (Ratio domestic sales)	4.8	4.70
Size of entrants relative to incumbents	18%	17.58%
7-year survival rate of entrants	48%	44.22%
Exit rate	8%	6.7%
Average firm size (employment)	80.3	82.81
Growth rate	3%	2.99%

Analyzing the 1992 Census of Manufacturers Bernard et al. (2003) report that the proportion of exporters is 21 percent for the U.S. They also show that exporting firms have a size advantage of 4.8 for the ratio of average U.S. sales. This measure is the ratio of average output of exporting plants to the average for non-exporting plants. The survival rate of firms seven years after entry in the market is 48 percent according to Bartelsman et al. (2004) for the U.S. manufacturing sector. They also find that the exit rate averaged over the time period 1989 to 1997 is approximately 8 percent, and that the size in terms of employment of new firms is 18 percent of incumbents size. Using the same dataset, Bartelsman et al. (2003) show that the average size of manufacturing firms in the U.S. is 80.3 in terms of employment. The annual growth rate is set to 3 percent, which is the average output growth rate in the 1990s according to the NIPA tables. The calibration

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targets and the values generated by the model are given in Table 1.1. All targets are reasonably well matched by the model statistics.

Table 1.2: Parameter values

Parameters from Literature		
θ	3.8	Elasticity of substitution
β	0.95	Discount factor
Parameters from Calibration		
f^p	8%	Fixed costs of production, % of average output
f^e	294%	Fixed costs of entry, % of average output
f^x	1.17%	Fixed costs of exporting, % of average exporters output
σ_e^2	0.55	Variance of entrants distribution
σ_η^2	0.15	Variance of incumbents shocks
τ	1.14	Variable costs of exporting
κ	72.38%	Relative distance between the entrants mean and the average of producing firms

The parameter values resulting from the calibration are summarized in Table 1.2.[7] Fixed costs of production and entry are given in percentage of output of the average producing firm. Fixed costs of exporting are given as percentage of the average output of exporting firms.[8] Note that the fact that the variance of the entrants distribution is substantially higher than the variance of incumbents shocks is consistent with evidence provided by Bartelsman and Dhrymes (1998): they find that young plants face more uncertainty about their productivity than older plants. The variable trade costs τ take the value 1.14. The imitation parameter is given as the relative distance between the mean productivity level of entrants and the average productivity level of producing firms: new firms have a productivity of approximately 72% of the average productivity of incumbents. This matches closely the empirical finding of Jensen et al. (2001).[9] The parameter values taken from the literature are the following: The discount factor β is set to 0.95, which implies an annual interest rate of approximately 5 percent. For θ, the elasticity of substitution between any two varieties, the value adopted form the literature is 3.8. It is taken from Bernard et al. (2003), who obtain this value by calibrating their model to fit U.S. plant

[7]The average productivity measure used to calculate the measures in which the fixed costs and the imitation parameter are expressed, is the non-weighted average.

[8]f^x as percentage of average output of all producing firms is 33%. This figure seems quite high. However, the average producing firm in this case is not an exporter, but produces only domestically.

[9]Jensen et al. (2001) find that in their panel the average productivity of entrants in 1992 is 45 in terms of value-added per hours worked in 1987 Dollars, while the average productivity in the industry is 54. This yields a relative distance of 83.33% between the two groups. However, only data form census years is considered, hence entrants in 1992 are firms that entered between 1987 and 1992 and are still alive in 1992. Recalculating the relative distance generated in my model, taking the mean of entrants which entered in the last 5 years and are still alive in year 5, yields a relative distance of 83.72%.

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and macroeconomic trade data.[10]

1.4.2 Results

In this section the solution of the model is discussed. Appendix B describes the algorithm used to obtain this solution. The aim of the chapter is to analyze how trade affects growth.

Unambiguously, opening up to trade yields a higher growth rate: As can be seen in Table 1.3 it increases by 15 basis points from 2.84% to 2.99%, meaning that the growth rate is more than 5 percent higher in the open economy. Considering that the effect on the growth rate is due only to an increase in selection, disregarding any other source of variation, this is a substantial change.

Table 1.3: Model results

Closed vs. Open Economy		
	Closed Economy	Open Economy
Growth Rate	2.84%	2.99%

So far the analysis consisted of comparing the steady states of autarky and open economy. More realistically I will now analyze trade liberalization in the open economy, i.e. the decrease in trade costs. How does a cheaper access to export markets affect the growth rate of the economy? As can be seen in Figure 1.2, a decrease in the variable costs of trade in the model leads to higher gain in aggregate productivity growth compared to the autarky case.[11]

The intuition behind this effect is simple. When variable costs of trade decrease, the productivity level necessary to derive positive profits form export markets is lower. Hence, the export cutoff level φ^{*x} decreases and more firms have access to foreign markets. Now more firms serve the market abroad. Hence the demand for labor necessary for the additional production and for paying the fixed costs of exporting increases. This drives real

[10] This value is lower than usually in the literature, hence the resulting markup is higher. However, the presence of fixed costs in the model justifies this choice of θ. See Ghironi and Melitz (2005) for a more detailed discussion.

[11] Note that the growth differential for the baseline value from the calibration is higher than 15 basis points in this graph. This is because the number of grip points is higher in this exercise than in the baseline case. Also, the steps in the figure come from the discretization necessary to compute the numerical solution. The results here are computed for 1000 grid points, and a substantially larger number would be needed in order to obtain a smooth line.

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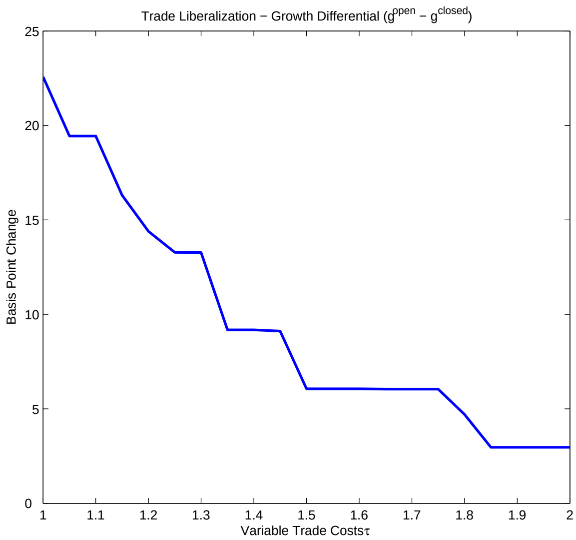

Figure 1.2: Growth Effect of a Change in Variable Costs of Exporting

wages up, which means that it is no longer profitable for the least productive firms to stay in the market. The production cutoff level φ^* hence increases: higher exposure to international trade has as consequence that firms with the lowest productivity levels in the economy have to exit the market. The implications of the higher cutoff level is that each remaining firm has now a higher probability to be hit by a bad shock which forces it out of the market. This tougher selection makes the economy profit from an increase in its growth rate. The same is true for a decrease of fixed trade costs.

The distributions of producing firms and entrants is shown in Figure 1.3. The firm distribution is skewed to the right. This is consistent with well established empirical evidence. Note that the entrants distribution is lagging behind the incumbents distribution. This due to the imperfect imitation process characterizing entry.

1.4.3 Competition and the Growth Effect of Trade

In the previous discussion it has become clear that trade-induced selection is an important factor which influences the growth rate of the economy. How this is related to competition aspects is explained in more detail in this section.

The quite restrictive assumption of CES preferences has some important implications for the competition effects in this model. Since the elasticity of substitution is constant, it does

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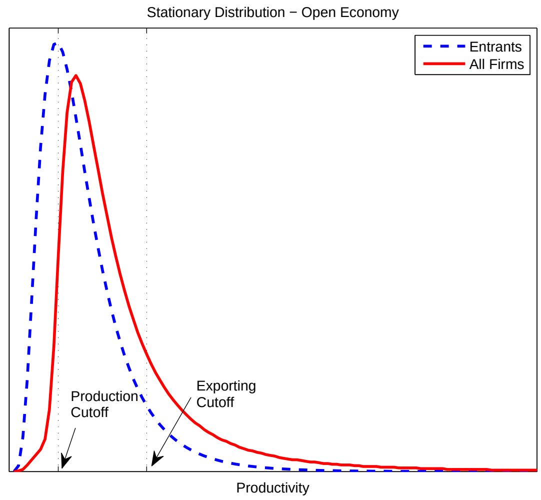

Figure 1.3: Stationary Distribution Open Economy - Entrants and all Firms

not adjust to a change in the number of competing firms or prices. The markups charged by firms are constant, hence their prices do not vary with the increase in competition. Thus, there is no competition effect in the sense of price adjustments by firms.

However, the elasticity of substitution directly affects the growth rate. It is an indicator of how competitive the economy is. When θ is low, different varieties are only very imperfect substitutes, which implies a low degree of competitiveness in the market. Opposite to this, high values of θ stand for higher competitiveness. Thus different levels of elasticities imply different growth rates because selection plays a more or less important role. Since the markup depends negatively on the demand elasticity, a low θ yields a high markup. In this case, since firms can charge a high markup, less productive firms can make profits which are high enough to stay in the market. This means that for low elasticities, selection does not play a big role. Hence, the higher the elasticity of substitution, the more competitive the market and the higher the growth rate.

Figure 1.4 shows how the growth rate difference between the open and closed economy varies with θ. That this difference in growth rates is not constant but hump shaped comes from the fact that the trade-induced additional selection impacts the economy differently for different levels of competitiveness. The explanation for the increase in the range of relatively low values of θ is as follows. Allowing for trade leads to an increase of the aggregate productivity level, and hence to a decrease in the aggregate price level. The

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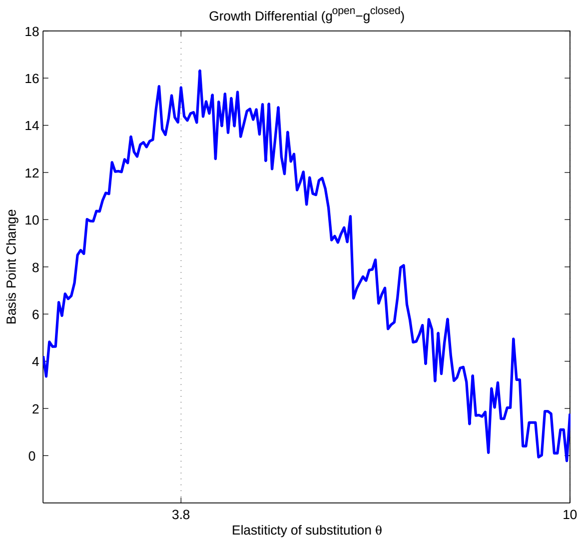

Figure 1.4: Effect of the Elasticity of Substitution on the Growth Differential

demand for each variety depends on the relative price charged for the specific variety: The higher the relative price, the lower the demand for this good, and a decrease of the aggregate price level directly implies an increase in relative prices. How consumers react to a change in relative prices depends on the elasticity of substitution θ. For low values of θ, consumers do not react a lot to this change in relative prices. Thus the loss in market shares of low productivity firms is limited, and some less efficient firms can continue to survive in the market. This means that for low values of θ the trade-induced selection effect has a relatively weak effect on the domestic economy in terms. When θ increases, the additional selection effect coming from trade plays an increasingly important role in the economy. The intuition behind the decrease in the growth differential in the range of relatively high values of the elasticity of substitution is similar: larger values of θ stand for more competition, different varieties are close substitutes. In this case, competition in the economy is very important. Additional selection induced by trade is then marginal and has a small, or no effect on the economy. Thus the growth differential decreases with an increased substitutability between goods.

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1.5 Conclusion

This chapter has analyzed the impact of opening up an economy to costly trade on the productivity growth rate. For this purpose an endogenous growth model with firm heterogeneity and intra-industry trade has been developed. Growth is generated by selection of more productive firms into the market. The least productive firms are forced to exit. Incumbent firms are hit every period by an idiosyncratic productivity shock and entrants are able to partly imitate successful incumbents. Exposure to international trade has the effect to increase the minimum productivity level required for production. This makes selection tougher, i.e. forces more low-productivity firms to give up their position in the market, and hence increases the growth rate of aggregate productivity.

For the last years there has been an ongoing debate about the benefits and shortcomings of globalization. One of the main fears is that opening up to trade could force some firms to close down. The model developed in this chapter does not allow for a general statement about the relation between trade and growth. However one very important conclusion can be drawn: considering the channel of the selection effect of trade on growth, countries that open up to trade will face closure of firms, but will gain in aggregate productivity and grow at a faster rate. It follows that in the short run, a protectionist policy could preserve some job opportunities. The long run consequences are however likely to be lower average productivity levels, higher prices and lower growth rates.

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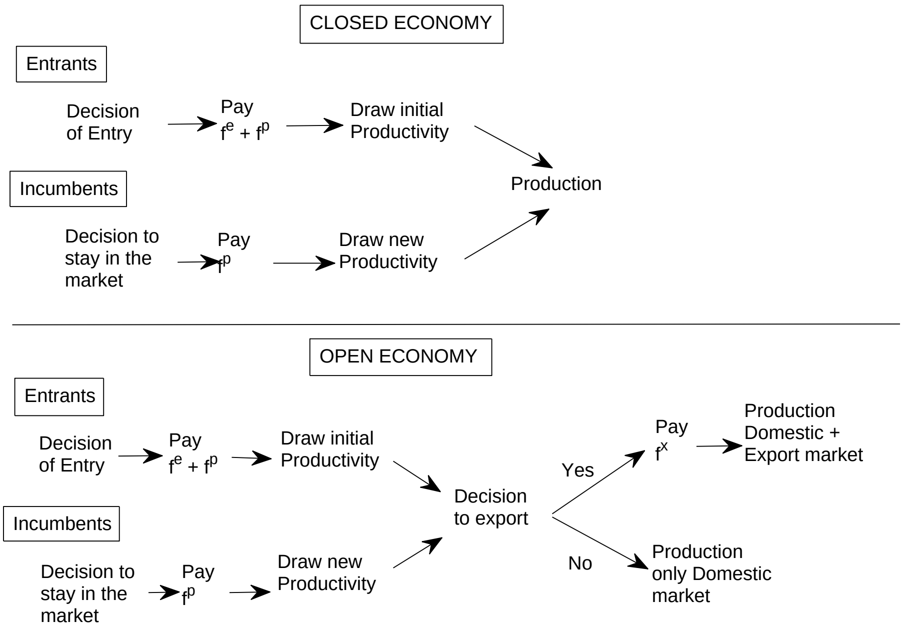
Appendix A: Timing



Appendix B: Algorithm

The algorithm used to obtain the numerical solution of the balanced growth path constructed in the following way.

First the state space of productivities is discretized, which means that a grid of productivities $\hat{\varphi}$ is created. The number of grid points is set to 200. A higher number of grid points does not have an implication on the main results of the model. Then the variable k and the growth rate g are guessed. For a given k and g, the transition probability matrix $\nu^{\epsilon}(\hat{\varphi}'/\hat{\varphi})$, denoted T, can be computed, taking into account the downward drift according to equation (1.17). The next step is to create the distribution of entrants $\gamma(\hat{\varphi})$, which is assumed to be lognormal. Then the variable k can be determined using the free entry condition, i.e. the k is computed for which the free entry condition (1.21) holds, given g. This allows then to compute the value function (1.19) by value function iteration. Firms which get a negative value from production choose to exit, hence the cutoff productivity level $\hat{\varphi}^*$ is known. The cutoff level allows then to create a transition probability matrix

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T_x which includes exit. Using this, the stationary firm distribution, for given g, can be obtained directly by $\mu = (I - T_x)^{-1}\gamma$. In the case of the open economy the decision of entering the export market has to be included. This is done by evaluating the profits for exporting, π^x, for every existing productivity level. Firms with $\pi^x > 0$ decide to export, and other firms only serve the domestic market. This also delivers the export market cut-off $\hat{\varphi}^{*x}$. Profits made from exporting enter the overall profits which are used to compute the value function. The last step is to obtain the growth rate g. This is done via the imitation mechanism. The mean of the entrants distribution is normalized to zero, and the equilibrium growth rate is the one fulfilling equation (1.8).

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Chapter 2

Importing Discipline: Trade in a Model of Endogenous Corruption

Joint work with Oskar Nelvin

2.1 Introduction

In the current chapter, we identify a channel through wich trade opening can influence bureocratic corruption, and argue that trade liberalization can be a potentially potent policy tool in the fight against corruption.

We incorporate a model of endogenous corruption into an intra-industry trade model with firm heterogeneity. Exogenous trade opening leads to tougher competition and consequently reduces the officials' ability to extract rents from firms. Trade liberalization therefore leads to a reduction in bribes charged to individual firms. In addition, as corruption distorts entry decisions and hampers welfare, trade liberalization has a stronger welfare enhancing effect under corruption than in a bribe free economy. We also analyze the incentive for governments to control corruption. When trade is liberalized, firms become more sensitive to the relative corruption level between countries. Governments therefore have stronger incentives to fight corruption when trade costs are low. Finally we test empirically the main prediction of the model, i.e. that higher trade costs lead to higher levels of corruption. Though our empirical strategy falls short of full causal

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identification, we show that countries that suffer from high trade costs due to a remote or innacessible location, also tend to experince higher levels of corruption.

The importance of bureaucratic corruption as an economic phenomenon can hardly be overstated. Previous research has shown that corruption reduces long term investment by increasing uncertainty (Wei (2000)), distorts investment and technology choices (Gray and Kaufmann (1998)), undermines the state‘s ability to collect revenue by pushing firms underground (Mauro (1998)) and reduces economic growth (Mauro (1995)).

A relatively recent empirical literature studies the causes of corruption. Openness to trade, high income levels, democratic rule, high bureaucratic wages, as well as certain historical or cultural features, such as protestant tradition, ethnic homogeneity and British colonial rule, have all been shown to be associated with lower levels of bureaucratic corruption (see for example Treisman (2000) and Lederman et al. (2005)). Of these, trade openness can easily be singled out as the most policy relevant. History and traditions are exogenously given, institutions are hard and time consuming to change and the fact that higher income levels might reduce corruption is of little consolation to policy makers if income levels are low precisely due to rampant corruption. Trade policy on the other hand is generally under the direct control of policy makers.

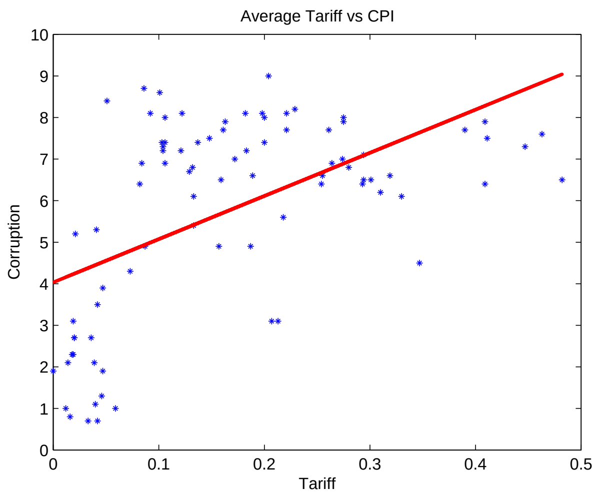

Figure 2.1: Average Tariff Levels vs Corruption Perceptions Index

Figure 2.1 plots Transparency Internationals Corruption Perceptions Index against average tariff levels as a proxy for trade openness [1]. The data reveals a clear negative correlation

[1]Data on average tariffs from Sachs and Warner (1995)

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between corruption and openness. Lower tariffs are associated with lower corruption levels. Svensson (2005) finds that of the worlds most corrupt countries all, except for Indonesia, are defined as closed economies according to the Sachs and Warner (1995) definition. Further, empirical work by among others Dutt (2009) and Ades and Di Tella (1999), establishes a negative correlation between trade openness and corruption.

In our model, trade liberalization is taken as exogenous. It is trade that impacts corruption, not the other way around. We do recognize that the causality could often be the reverse: Countries fail to liberalize due to the existence of strong special interest groups and poor institutions. However, to focus attention on the effect of trade on bureaucratic corruption we abstract from this possibility.

As in Shleifer and Vishny (1993), we consider the sale of government property by government officials as the prototype of corrupt activities. We do not model an agency relationship, but simply assume that officials have the power to extract rents from existing firms and focus on analyzing the demand for bribes. Like in Choi and Thum (2005), paying the bribe is not associated with any type of cost reduction; it is simply a case of either paying or being forced to exit. We can for example think of the officials as bureaucrats working for a regulatory agency with the power to approve or deny an application for an operating- or export license.[2] Another interpretation would be that the bribe is paid in order for the firm to avoid complying with some very costly regulation, which would in any case have made it uncompetitive.

We consider a model with two types of officials: domestic officials and export officials. Domestic officials try to extract bribes from firms selling in the domestic market, while export officials can extract bribes from firms that want to access foreign markets. The domestic officials could hence be thought of as being able to approve or deny a domestic operating license, whereas the export officials can grant an export license. All bribes take the form of fixed cost payments.

[2]The most straight forward interpretation is a bribe paid in order to get an operating license. Around one third of firms in low income countries report that they have to pay bribes in order to receive an operating license, and in some countries the figure is substantially higher, around 63% in Mexico and 70% in Syria. Djankov et al. (2002) show that entry costs are highly correlated with corruption levels in a cross section of countries. The corrupt payment could also be interpreted more generally: as bribes need to be paid in order to keep the firm running. This would include an operating license, but also bribes necessary to get a telephone line etc. This interpretation would be close to what the World Bank calls "Bribes to get things done". Around 50% of firms in low income countries report to have to pay bribes to "get things done" according to the World Bank enterprise survey, and for many countries the figure is far above 80%.

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Both types of officials are many in number and do not coordinate their rent seeking activities. Each official sets the bribe in order to maximize his expected private utility. Though each individual official does know how the economy works, as well as the productivity distribution of firms, the productivity of any individual firm is private information. The official is hence unable to price discriminate and constrained to demanding a uniform bribe from all firms[3]. When setting the bribe, the official faces the following trade-off: If the bribe is set too high it will induce excessive exit[4] and the official might walk away empty-handed as the firm he is dealing with closes down or chooses to exit the export market. On the other hand, if the bribe is set too low, potential revenue is forfeited. The optimal uniform bribe is the one that maximizes the officials expected revenue.

The model of endogenous corruption is incorporated into a static trade model based on Melitz-Ottaviano (2008). As in the basic version of Melitz and Ottaviano (2008) we consider a two country world. We assume the two countries to be symmetric. Firms are heterogeneous in productivities, and the productivity distribution is Pareto. Trade liberalization takes the form of a bilateral reduction in the variable cost paid to import into the country. One could think for example of the creation of a free trade area in which both countries bilaterally reduce their import tariffs. A reduction in import costs could also be seen as stemming from improvements in infrastructure.

The remainder of the chapter is structuread as follows: In Section 2.2 we present the model. Section 2.3 analyzes how trade liberalization affects the optimal bribe and other equiblibrium outcomes. In Section 2.4 we introduce a government to look at how trade liberalization affects incentives to control corruption. In Section 2.5 we test empirically the predicted relationship between trade costs and corruption. Section 2.6 concludes.

2.2 The Model

In this section we present our model of endogenous corruption in an open economy framework. The model is heavily based on Melitz-Ottaviano (2008), but we depart from their

[3]Previous research show that, at least in the subset of formal sector firms, smaller firms are hit harder by corruption relative to larger ones (Schiffer and Weder (2001)). By modeling the bribe as a one part tariff we are able to replicate this stylized fact in a simple manner.

[4]Romer (1994) also suggests that corruption can drive firms out of the market, and shows that this induces a large welfare loss

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set-up in one important respect: In the current model, access to both the domestic and export markets require the payment of bribes to corrupt officials.

We consider a two country world populated by two entirely symmetric countries. International trade is possible, but costly. Trade costs are modeled as iceberg cost, $\tau > 1$.

The section is structured as follows: In subsection 2.1 we provide a full description of the economy. Throughout this subsection bribes are treated as exogenous fixed costs of production and exporting. In section 2.2 we present the official's problem and endogenize the bribe level.

2.2.1 The Bribe Economy

Consumers

Consumers preferences are defined over a continuum of differentiated varieties, and a homogeneous good chosen as a numeraire. The utility function of each consumer is given by:

$$U = q_0^c + \alpha \int q^c(\omega) d\omega - \frac{1}{2}\gamma \int (q^c(\omega))^2 d\omega - \frac{1}{2}\eta \left(\int q^c(\omega) d\omega \right)^2,$$

where q_0^c represents consumption of the homogenous good, and $q^c(\omega)$ represents the consumption of each heterogeneous variety ω. The demand parameters α, γ and η are all positive. α expresses the intensity of preferences for the differentiated products relative to the homogenous good, γ reflects love of variety and η denotes the substitutability between different varieties. Consumers maximize utility subject to a standard budget constraint. This yields the following linear demand system for each variety ω:

$$q(\omega) = \frac{L\alpha}{\eta N + \gamma} - \frac{L}{\gamma} p(\omega) + \frac{L}{\gamma} \frac{\eta N}{\eta N + \gamma} \bar{p}, \tag{2.1}$$

where L is the population size (from now on we assume $L = 1$ as we are not interested in scale effects), N is the number of firms serving each market and $\bar{p}$ is the average price level: $\bar{p} = \frac{N^e}{N} \left(\int_0^{c^*} p^d(c) g(c) dc + \int_0^{c_x^*} p^x(c) g(c) dc \right)$, with N^e being the number of entrants and c^* and c_x^* the cost cutoff levels of production and exporting respectively (see section

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2.2.1).

Welfare of consumers is given by the indirect utility function:

$$U = 1 + \frac{1}{2}\left(\eta + \frac{\gamma}{N}\right)^{-1}(\alpha - \bar{p})^2 + \frac{1}{2}\frac{N}{\gamma}\sigma_p^2. \tag{2.2}$$

Firms

Labor is the only factor of production and is inelastically supplied in a competitive market. The numeraire good is produced under constant returns to scale at unit cost, and its market is competitive. These assumptions imply a unit wage.

Production in the differentiated product sector exhibits constant returns to scale at a marginal cost c. Throughout the chapter we assume firms' productivities to be Pareto distributed, which means that marginal costs are distributed according to

$$G(c) = \left(\frac{c}{c_m}\right)^k,$$

with support over $[0, c_m]$. The parameter $k > 1$ determines the shape of the distribution.

The marginal cost of an individual firm is only known after it has made an irreversible investment of f^e required for entry. In addition, once a firm has drawn its cost level, it is assigned to a domestic official, and (if it would like to enter the export market) to an export official. The assigned official(s) quote the firm a bribe. Firms that refuse to pay the bribe are forced to exit the relevant market, while the firms that agree are allowed to start production.

As markets and bribes are segmented, and firms produce under constant returns to scale, domestic- and export profits are maximized independently. Domestic profits π^d and export profits π^x are given by

$$\pi^d(c) = (p^d(c) - c)q^d(c) - d,$$

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$$\pi^x(c) = (p^x(c) - \tau c)q^x(c) - x,$$

where $p^d(c)$ denotes the prices charged in the domestic market and $p^x(c)$ the price charged in the export market. τ is the variable iceberg-type trade cost, and d and x are the bribes charged by the domestic and the export official respectively. The profit maximizing domestic and export output levels, $q^d(c)$ and $q^x(c)$, are given by:

$$q^d(c) = \frac{1}{2\gamma}\left(\frac{\alpha\gamma + \eta N\bar{p}}{\eta N + \gamma} - c\right), \tag{2.3}$$

and

$$q^x(c) = q^d(\tau c). \tag{2.4}$$

Only firms with a low enough marginal cost of production will generate high enough profits to be able to cover the bribe.[5] Thus there exists a production cutoff level c^* and an export cutoff level c_x^*. Firms with a cost level higher than c^* will choose to exit rather than paying the bribe, and firms with a cost level higher than c_x^* will choose only to serve the domestic market.

Equilibrium

The equilibrium of the economy is determined by goods market clearing, the zero cutoff profit condition and the free entry condition. Appendix B specifies how the algorithm used to obtain the solution is constructed.

Goods Market Clearing: Combining optimal demand (2.1) with optimal supply for the domestic market (2.3), and the export market (2.4), yields the price which clears the market for the good produced by a firm with marginal costs c. The domestic goods market and the export goods market clear at the following prices:

[5] Even in absence of bribes, i.e. $d = x = 0$, there exist cutoff levels of production and exporting. This is due to the specification of the demand structure. Above a certain threshold price, demand is driven to zero. Hence firms with a cost structure forcing them to charge prices above this threshold can not make positive profits and have to exit the market.

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$$p^d(c) = \frac{1}{2}\left(\frac{\alpha\gamma + \eta N\bar{p}}{\eta N + \gamma} + c\right), \tag{2.5}$$

$$p^x(c) = p^d(\tau c). \tag{2.6}$$

Zero Cutoff Profits: The production and export cutoff levels are given by the zero-cutoff profit conditions $\pi^d(c^*) = 0$ and $\pi^x(c_x^*) = 0$ respectively. All firms with costs $c < c^*$ will serve the domestic market, and all firms with costs $c < c_x^*$ will supply the export market.

Free Entry: A firm only considers entry if its expected profits are large enough to cover the fixed entry cost f^e. The free entry condition is therefore given by:

$$\frac{1}{2\gamma}\left[\int_0^{c^*}\left(\left(\frac{\alpha\gamma + \eta N\bar{p}}{\eta N + \gamma} - c\right)^2 - d\right) dG(c) + \int_0^{c_x^*}\left(\left(\frac{\alpha\gamma + \eta N\bar{p}}{\eta N + \gamma} - \tau c\right)^2 - x\right) dG(c)\right] = f^e. \tag{2.7}$$

The number of entrants in the economy is determined by $N_e = \frac{N}{G(c^*)+G(c_x^*)}$.

2.2.2 The Officials Problem

So far we have considered bribes as a fixed cost of production and exporting. In the current section we will present the officials problem and describe how bribes are endogenized. Before we move on, we would however like to highlight two important assumptions.

Firstly, officials are atomistic. By this we mean that each official is assigned only one or a small number of firms, and that their corrupt activities are not coordinated. This implies that each individual official takes the average bribe level as given, even though the level of bribes affects the economy in equilibrium. The problem of each individual official can therefore be treated as the problem of an official acting in a bribe free economy.

Secondly, the cost c of an individual firm is private information. Though the officials do know how the economy works, as well as the distribution of costs, they do not know the cost level of the individual firm(s) assigned to them[6]. Further, high cost firms have no

[6] If the cost level of each firm had been common knowledge, domestic and export officials would have quoted each firm with a bribe equal to its future profits in the domestic- and export market respectively.

possibility to signal their status. This implies that officials are constrained to charging a uniform bribe from all firms.

A firm will only be willing to pay the quoted bribe if its future expected profits from the relevant market exceeds the amount of the bribe. The official therefore faces a trade-off. If he quotes a too high bribe, the firm's profits might not be high enough to cover the payment, and the firm will exit leaving the official empty-handed. On the other hand, if the quoted bribe is too low, potential revenue is forfeited. The domestic and export officials' problems are therefore to maximize expected revenue[7] according to

$$Exp(R(d)) = d \times Pba(\pi_0^d(c) - d > 0), \tag{2.8}$$

and,

$$Exp(R(x)) = x \times Pba(\pi_0^x(c) - x > 0), \tag{2.9}$$

respectively. $Exp(R(d))$ is the expected revenue of a domestic official and $Exp(R(x))$ is the expected revenue of an export official. $Pba(\pi_0^d(c) - d > 0)$ and $Pba(\pi_0^x(c) - x > 0)$ represent the probabilities of the domestic and export officials to receive the bribe d and x. The subscript 0 stands for the bribe-free economy.[8]

In a bribe free economy, i.e. in an economy where $d = 0$ and $x = 0$, profits in equilibrium can be rewritten as $\pi_0^d(c) = \frac{1}{4\gamma}(c_0^* - c)^2$ and $\pi_0^x(c) = \frac{1}{4\gamma}\tau^2(c_0^*/\tau - c)^2$.[9] Given these expressions and the Pareto assumption, we can find an expression for the probability that a randomly assigned firm would be willing to pay the bribe:

$$Pba(\pi_0^d(c) - d > 0) = c_m^{-k}\left(c_0^* - (4\gamma d)^{1/2}\right)^k, \tag{2.10}$$

$$Pba(\pi^x(c) - x > 0) = c_m^{-k}\left(c_0^*\tau - (4\gamma x)^{1/2}\tau^{-1}\right)^k. \tag{2.11}$$

The cost cutoff levels would then be equal to the cost cutoff levels in an economy with $d = 0$ and $x = 0$ regardless of the size of the bribe.

[7] We assume the official to be risk neutral

[8] The bribe free economy is equivalent to the original Melitz and Ottaviano (2008) model.

[9] See Melitz and Ottaviano (2008) for a detailed derivation.

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We plug equation (2.10) into equation (2.8), and equation (2.11) into equation (2.9), and by maximizing we obtain the equilibrium bribes d^* and x^*. As it turns out, under symmetry, the equilibrium domestic bribe and the equilibrium export bribe are the same.[10], i.e. $d^* = x^*$. To simplify notation we will therefore denote the optimal bribe in both the domestic and export markets by m^*, where $m^* = d^* = x^*$.

The equilibrium bribe level is given by

$$m^* = d^* = x^* = \frac{1}{\gamma(k+2)^2}\left(\frac{\gamma\phi}{(1+\tau^{-k})}\right)^{2/(k+2)}, \tag{2.12}$$

where $\phi = 2c_m^k(k+1)(k+2)f^e$.

Three things that are interesting to note about the size of the bribe. Firstly, the bribe depends positively on γ, the parameter for love of variety. The intuition for this is quite simple: The higher γ, the more consumers value a heterogeneous consumption basket, and hence the more equal is the share of their expenditures spent on each variety. A higher γ therefore implies a higher cost-cutoff level and lower average profits. Lower profits means lower bribes. Secondly, the bribe depends positively on f^e, the fixed cost of entry. The higher the entry cost, the higher do expected profits have to be for firms to enter. Higher profits mean higher bribes. Thirdly, the bribe depends positively on τ, the variable trade costs. This will be the topic of the next section.

2.3 Trade Liberalization

In the current section we will analyze how trade liberalization affects equilibrium outcomes in an economy with bribes. Trade liberalization takes the form of a bilateral[11] reduction in the per unit trade cost τ.

2.3.1 Bribe level

Does freer trade lead to less corruption? In the current model this is the case.

[10]Note that this result is dependent on the distributional assumption made.
[11]This as we are studying a symmetric two country model.

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$$\frac{\partial m^*}{\partial \tau} = \frac{2\phi k}{(k+2)^3} \frac{1}{\tau^{k+1}(1+\tau^{-k})^2} \left(\frac{\gamma \phi}{L(1+\tau^{-k})} \right)^{-k/(k+2)} > 0 \tag{2.13}$$

As can be seen in equation 2.13 the derivative of m^* with respect to τ is always positive. Hence bilateral trade liberalization always decreases the optimal bribe charged by corupt officials.

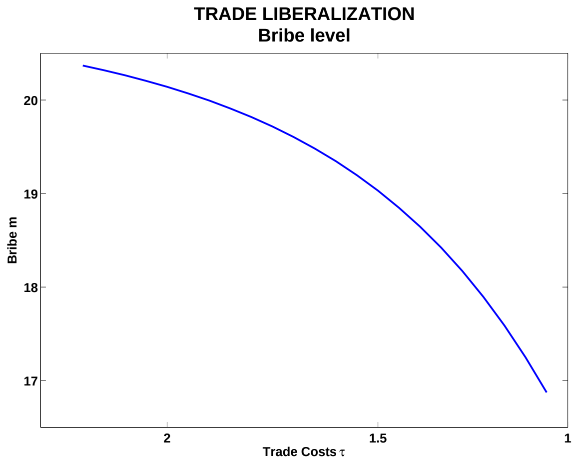

Figure 2.2: Trade liberalization and the bribe

The result is illustrated in figure 2.2. The bribe charged by both domestic- and export officials, m^*, is always increasing in τ. Trade liberalization leads to increased import competition in the domestic product markets, resulting in a lower cost cutoff level and lower markups. This leaves less resources to extract for the official, and thereby to a lower equilibrium bribe. Trade liberalization does not only decrease the individual bribes charged by officials, but also total bribes charged over total revenue.

Having concluded that lower trade costs implies lower levels of bribes, we can now move on to analyze how trade liberalization impacts the cost cutoff level, and thereby the competitiveness of the economy, under the existence of bribes.

2.3.2 The cutoff

Bilateral trade liberalization opens up both countries for competition from foreign firms, thus forcing the most unproductive domestic firms to exit. The production cutoff level is thereby reduced. This is the standard Melitz-Ottaviano (2008) result. As can be seen in

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Figure 2.3, the introduction of bribes into the model has two interesting effects. Firstly, the cutoff level is lower under bribes for all values of τ, i.e. the bribe economy is more competitive than the non-bribe economy[12]. Secondly, the slope of the bribe economy curve is somewhat flatter, i.e. trade liberalization has a weaker pro-competitive effect under bribes.

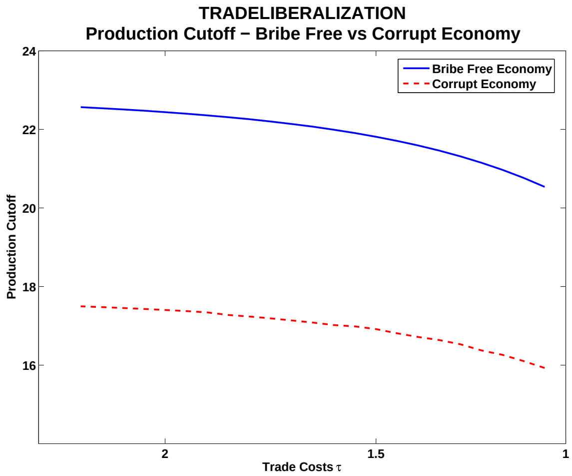

Figure 2.3: Competition and Trade Costs

The presence of bribes affects the cut-off level through two opposing channels:

(1) For a given number of entrants (N_e) corruption lowers the cutoff level. The intuition is simple: In a bribe free economy all firms that are able to cover their marginal costs will enter. In the bribe economy, however, firms also need to be able to cover the cost of the bribe. Hence, some potential entrants with high cost draws will choose not to enter. The cutoff cost level is thereby decreased.

(2) Secondly, bribing works as a distortion which decreases the number of entrants (N_e), while leaving demand and marginal costs unaffected. This increases the cutoff level. The intuition is again simple; bribing transfers some profits from firms to officials, hence lowering average expected profits. Paying the fixed cost of entry thereby becomes less attractive, and the number of potential entrants decreases. In the bribe economy, less potential entrants are therefore available to serve the market. Competition for entry is

[12]This result is somewhat similar to the findings of Bardhan (1997). Bardhan (1997) argues that even without pre-existing distortions, corruption can lead to an efficient outcome in the sense that it allocates government licenses and permits to the lowest cost producer. This argument of course assumes that other goals are not violated. For example, in the current model, corruption hurts consumer welfare by limiting the number of product varieties available.

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reduced, and the cutoff level is thereby increased.

It turns out that the first effect domintates, and the bribe economy is therefore characterized by a lower cost cutoff level than the no-bribe economy.

This also explains the flatter slope of the bribe economy. Trade liberalization leads to lower bribes, and hence to a lessened pro-competitive effect from corruption. Trade liberalization still leads to a more competitive market, but the effect is weakened by the decrease in bribes.

The next step is to look at how the welfare of consumers and officials is affcted by lower trade costs.

2.3.3 Welfare

Figure 2.4 plots consumer welfare (normalized by the welfare level of $\tau = 1.4$), see equation 2, against trade costs for a corrupt (endogenously determined m) and non-corrupt (m is exogenously set to zero) economy respectively. The red dotted line represents consumer welfare in an economy with bribes, the solid blue line consumer welfare in an economy without bribes. As in the original Melitz-Ottaviano (2008) model trade liberalization boosts consumer welfare by increasing competition and by making more product varieties available in the economy. This effect remains when corruption is introduced in the model. However, as trade costs are decreased, the level of bribes is also reduced. Bribes distort the entry desicion of firms and reduces the number of product varaities in the economy. As the bribe distortion is abated, the welfare enhanicing effect of lower trade costs is enhanced. Welfare therefore increses faster in a corrupt economy (as apparent by the steeper slope of the bribe economy curve) when trade is liberalized

What about the welfare of officials?. Export- and domestic official's welfare[13] (normalized by the welfare level of $\tau = 1.4$) is plotted in Figure 2.5. Welfare of export officials is represented by the dotted yellow line and welfare of domestic officials by the solid green line. Not surprisningly, Export official's gain in welfare when trade is liberalized. Though trade liberalization leads to a lower bribe beeing charged to each individual exporter, lower trade costs also lead to more export activity. The latter effect dominates, and total

[13]The officials ‘ welfare is defined as total revenue of export- and domestic officlas respectively.

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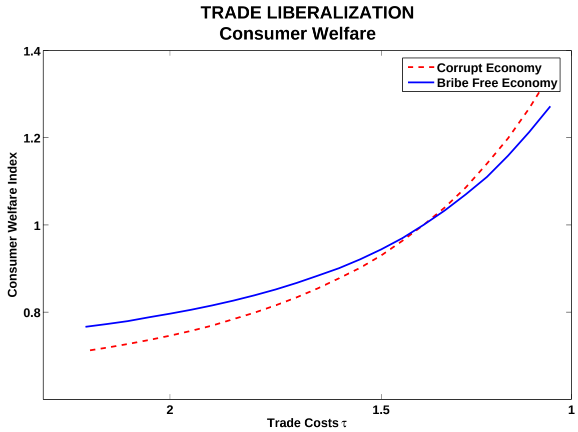

Figure 2.4: Welfare Consumers

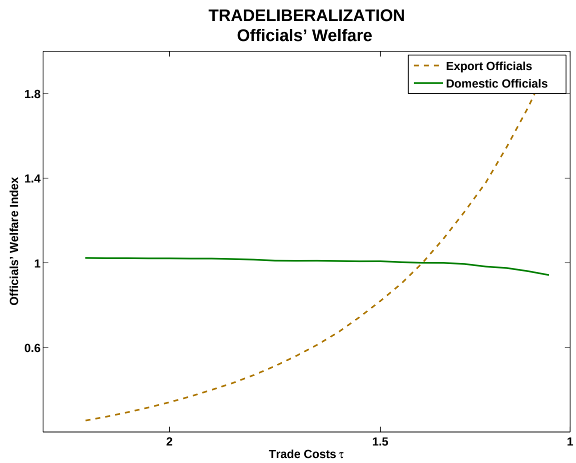

Figure 2.5: Welfare Officials

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revenue to export officials is thereby increased. Domestic officials, on the other hand, loose out when trade is liberalized. This due to the reduced bribe level.

The result is interesting from a coalition building perspective. Despite the fact that trade liberalization reduces corruption, corrupt export officials could still benefit from joining consumers in demanding lower tariffs, and thereby lower trade costs.

2.4 Trade liberalization and corruption control

Until now the officials of the economy have been free to set their bribe level without interference from any anti-corruption authority or law enforcement agency. In the current section we relax this assumption and introduce a government body. This body, below called the government, has as its only role to oversee the officials and to try to curb corruption. We show that trade liberalization leads to more effort being put into reducing corruption, and thereby to a lower overall level of graft.

We assume that the government has at its disposal a bribe reducing technology. We are agnostioc about exatctly what this technology is, but one could think about incresed monitoring of officials, or longer jail sentences for those that are caught. In any case, reducing the bribe level requires the governmnet to put in some effort. Effort can be transformed into reduced bribes given the following production function:

$$m_i^f = m^* - \Gamma e_i^{\frac{1}{\delta}}, \tag{2.14}$$

where m_i^f is the post effort bribe level and e_i is the effort level of the government in country i. Γ is a scalar that determines how potent effort is in reducing the bribe. We assume decreasing returns to effort, i.e. $\delta > 1$.

The government is benevolent and interested in maximizing consumer welfare However, it also receives disutility from exerting effort. Its objective function takes the following form:

$$U_i^{GOV} = W_i^c - \theta_i e_i,$$

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where W_i^c is consumer welfare (as per equation 2) in country i, θ_i is a parameter which determines how much weight the government put on welfare versus the disutility of effort exertion.

The government chooses its effort level by maximizing its utility with respect to e_i, subject to the corruption reducing production function (2.14). Governments are assumed to not coordinate their corruption reducing activities. To solve for the welfare maximizing effort level we therefore have to rewrite the model from section 2.2 in a form that allows assymetry in bribes. This version of the model is presented in Appendix C.

We are interested in how trade liberalization impacts the government's incentive to exert effort to curb corruption. Figure 2.6 below plots the optimal effort level against trade costs τ.

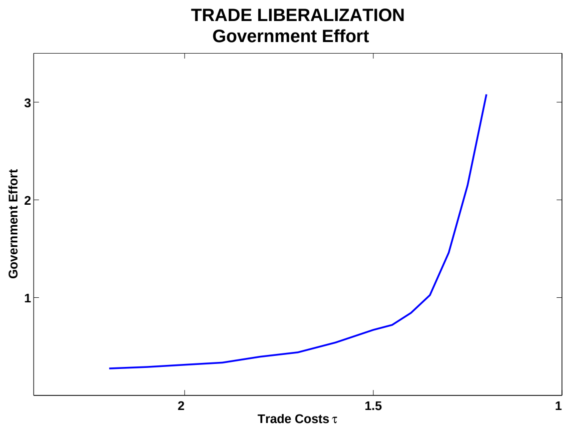

Figure 2.6: Government effort and trade liberalization

The effort level is clearly increasing with lower trade costs. The intuition for this result is quite straight forward. The larger the number of firms willing to enter the domestic economy, the larger is the number of avaliable product varaities and the lower is the average price level. Governments therefore have a strong incentive to try to convince firms to locate in their own country rather than in the neighboring state (this is true as long a $\tau > 1$). When trade costs are high, exporting is expensive and firms that want to supply the market of a specific country have a strong bias towards locating in that country. However, as trade costs are reduced, firms become increasingly more flexible in their location decision. This means that they also become more sensitive to the relative bribe levels in the respective countries. The lower the trade costs, the more important it

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therefore becomes to offer a relatively uncorrupt domestic economy that can attract firms from neigbouring countries and deter local firms from leaving. Governments consequentely increase their effort in corruption curbing. As long as the other country has access to the same corruption curbing technology the end-result is lower corruption and higher welfare in both countries. It should however also be noted that countries that lack the capacity to reduce corruption might lose out when trade is liberalized. Though reduced trade costs are beneficial both from a corruption curbing and pro-cometitive perspective, countries that fail to control graft might still suffer as firms relocate to less corrupt contries. In such cases the overall welfare effect of trade liberalization is ambigious.

2.5 Corruption and Remoteness

Our model implies that high trade costs should be associated with high levels of corruption. In the Introduction we showed that this is indeed the case. Countries with high levels of trade protection in terms of tariffs also tend to suffer from higher levels of corruption as measured by the Transparency International Corruption Perception Index. However, if countries fail to liberalize trade due to the existence of strong special interest groups or poor institutions, this result could be driven by reverse causality. To overcome this problem we need to consider trade costs that can argubly be considered as exogenous to corruption. One alternative would be to use real transport costs. However, transport costs are correlated to the quality of infrastructure and therefore suffer from potential endogeneity problems. Further, reliable data on transport costs for a large number of countries is almost impossible to come by (Hummels and Lugovskyy (2006)). As a solution we will instead make use of geographical proxies for trade costs. Distance to major trading centres as well as geographical characteristics, such as the lack of sea access, have been shown to be important determinants of transport costs (Limao and Venables (2001)). Using these proxies we show that, in line with the predictions of the model, more remotely located and less easily accessible countries, do indeed suffer from higher levels of corruption.

Limao and Venables (2001) investigate the determinants of trade costs. Landlocked countries, and countries located far from potential trading partners are found to suffer from high trade costs, whereas islands are found to benefit from lower costs of trade. Overland

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transportation is found to be as much as 7 times as expensive as sea transportation, and of the top 15 export performers between 1965-90, 8 are islands, and none are landlocked.

As a proxy for distance we construct two different, but closely related, measures. We want proxies that incorporate not only a country's degree of geographical remoteness, but also how far it is located from potential trading partners. We define $GDPdist_i$ as the average distance from country i's main city or agglomeration to the most important city or agglomaration of all other countries, weighted by GDP. $Tradedist$ is the same measure, but instead weighted by total exports. The data on geographical distance is obtained from CEPII, the GDP data from the World Bank and the trade data from UN Comtrade. Appendix D provides a more in-depth explanation for how these measures are calculated.

The inclusion of distance as a proxy for trade costs requires some additional comments. Though it is clear that distance is exogenous to transport costs, distance might also impact corruption through other channels. Countries located at close distance to each other are likely to share cultural ties and similar institutions. Further, richer countries are likely to be both larger exporters and to experience lower levels of perceived corruption. An observed negative relationship between our distance measures and corruption could therefore be due to institutional and cultural factors, rather than to transport costs. The results presented below should therefore be interpreted with some care.

To take into account the difference between overland and oversea transport costs we introduce the dummies $Island_i$, equal to one if country i is and island, and $Landlocked_i$, equal to one if country i is landlocked. We also introduce the variable $sea\%_i$, which is the percentage of country i's border that is made up by coast line (data from CIA World Fact Book). The more coast line a country has as a proportion of its total border, the easier should it be to access different parts of the country by sea. A higher value for $sea\%_i$ should hence be associated with lower transport costs.

As a proxy for a country's level of corruption we use the Transparency International Corruption Perception Index (CPI) and the Wall Street Journal-Heritage Foundation index of Freedom from Corruption (WSJ). Both indices are commonly used in the literature. We use data from 2009, as this year includes the most countries.

We regress our proxy for corruption on the proxies for distance and geographical charac-

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teristics. The results are available in table 2.1. All our trade cost proxies are statistically significant and have the right sign regardless of model specification and corruption index used. The best model specification explains almost 25% of the variation in the corruption index and the magnitude of the coefficients are economically significant. A reduction in $TradeDist_i$ by 2400 KM (equivalent to one standard deviation), is associated with an improvement in the CPI Index ranking by on average almost 6 places out of 65. A 40 percentage point increase in $sea\%_i$ (equivalent to one standard deviation) is associated with an improvement in the CPI Index ranking by on average more than 8 places. These finings are in line with the predictions of the model; more remote and harder to access countries do indeed seem to suffer from higher levels of corruption.

Table 2.1: Corruption and Remoteness - Estimation Results

	CPI 2009	**CPI 2009**	**CPI 2009**	**WSJ 2009**	**WSJ 2009**	**WSJ 2009**
TradeDist (1000km)	-0.30**	-0.29**		-0.31**	-0.32**	
	(0.09)	(0.09)		(0.09)	(0.09)	
GDPDist (1000km)			-0.34**			-0.36**
			(-0.11)			(0.10)
%Sea		2.6**	2.54**		2.67**	2.6**
		(0.37)	(0.37)		(0.36)	(0.37)
Island	1.64**			1.63**		
	(0.45)			(0.42)		
Landlocked	-0.75*			-0.77*		
	(0.33)			(0.34)		
R-Square	0.14	0.24	0.23	0.15	0.25	0.23
N	179	179	179	181	181	181

* Significant at 5% level, ** Significant at 1% level.
Robust standard errors.

2.6 Conclusion

In the current chapter we have identified a link between trade openness and bureaucratic corruption. Trade liberalization enhances product market competition and reduces the rents available for extraction by corrupt officials. As a result, bribes charged to firms are reduced and welfare is enhanced. In addition, we argue that among the determinants to corruption identified in the literature, trade openness can be singled out as one of the most policy relevant. History and culture are exogenously given, and institutions are hard

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and time consuming to change. Trade policy, on the other hand, is generally under direct control of policy makers.

We further analyzed the incentives for governments to fight corruption, and showed that benevolent governments exert more effort in combating corruption when trade costs are low. Trade opening makes firms more sensitive to other features of the business climate, like corruption, and thereby increases the return to good governance. It should however be pointed out that this argument comes with a downside. While openness to trade helps countries to control corruption and provides incentives for the creation of good institutions, lower trade costs also raises the stakes. Countries that are able to improve their business climate attract new firms, but countries that fail to do so might suffer. This could help explain why, in some cases, empirical studies of trade liberalization fail to identify the beneficial effects predicted in standard trade theory (for an overview see Lopez (2005)).

Our model predicts that countries which experience higher transport costs should suffer from higher levels of corruption. We test this prediction empirically, and show that more remote and harder to access countries do indeed tend to exhibit higher levels of perceived corruption. However, we also acknowledge that our identification strategy falls short of a full causal identification.

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Appendix A: Timing of the model

Figure 2.7 illustratetes the timing of the model. In the first period prospective firms need to decide whether or not to pay the fixed cost of entry, f^e. A firms that has decided to enter then draws a cost level, c. Once the firm knows its cost level it meets the assigned domestic official, and if it also wants to export, the assigned export official. The official(s) then quote a bribe. If the firm agrees to pay the quoted bribe(s) it can start production for the relevant market(s).

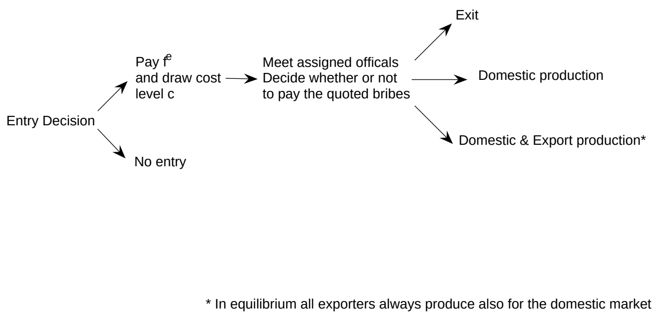

Figure 2.7: Timing of the model

Appendix B: Algorithm

The Algorithm to obtain the numerical solution of the economy presented in section 2.2 is constructed in the following way.

First we discretize costs, i.e. we build a grid of costs c. The number of grid points is set to 1000. We then guess the number of firms operating in each market, N, and the average price level $\bar{p}$. Given the guessed N and $\bar{p}$, the following expressions can the be computed: Equations (2.5) and (2.6), which yield the prices charged in the domestic and export market. Knowing prices, the consumers first order condition, equation (2.1), which determines demand, gives the quantities consumed $q^d(c)$ and $q^x(c)$. This in turn allows us to know the firms profits $\pi_d(c)$ and $\pi_x(c)$. Hence the cost cutoff levels of production c^* and exporting c^*_x can be determined given the zero cutoff conditions. We can then obtain the number of entrants N_e. Now we can use the expression for average prices in order to verify our initial guess for $\bar{p}$. We then iterate untill $\bar{p}$ converges. Once we have found the correct average price for the initial guess of N, we can use the free entry condition (2.7) to verify our guess on N.

Appenix C: Asymmetric Economy

In this appendix we show an asymmetric specification of the model. The symmetry assumption is relaxed only regarding bribes.

On the demand side the introduction of asymmetry has no impact. Consumers have the same linear demand for each variety as before, given by the following equation:

$$q_i(\omega) = \frac{\alpha}{\eta N_i + \gamma} - \frac{1}{\gamma} p_i(\omega) + \frac{1}{\gamma} \frac{\eta N_i}{\eta N_i + \gamma} \bar{p}_i, \tag{2.15}$$

where $\bar{p}_i = \frac{N_i^e}{N_i} \int_0^{c_i^*} p_i^d(c) g(c) dc + \frac{N_j^e}{N_i} \int_0^{c_{xi}^*} p_j^x(c) g(c) dc.$

Domestic and export profits are now given by:

$$\pi_i^d(c) = (p_i^d(c) - c) q_i^d(c) - m_i,$$

$$\pi_i^x(c) = (p_i^x(c) - \tau c) q_i^x(c) - m_i.$$

The equilibrium conditions are given by the following equations.

Goods market clearing:

$$p_i^d(c) = \frac{1}{2} \left(\frac{\alpha\gamma + \eta N_i \bar{p}_i}{\eta N_i + \gamma} + c \right),$$

$$p_i^x(c) = \frac{1}{2} \left(\frac{\alpha\gamma + \eta N_j \bar{p}_j}{\eta N_j + \gamma} + \tau c \right).$$

Zero cutoff profit conditions: $\pi_i^d(c_i^*) = 0$ and $\pi_i^x(c_{xi}^*) = 0$

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Free entry condition:

$$\frac{1}{2\gamma}\left[\int_0^{c_i^*}\left(\left(\frac{\alpha\gamma+\eta N_i\bar{p}_i}{\eta N_i+\gamma}-c\right)^2-m_i\right)dG(c)+\int_0^{c_{xi}^*}\left(\left(\frac{\alpha\gamma+\eta N_j\bar{p}_j}{\eta N_j+\gamma}-\tau c\right)^2-m_i\right)dG(c)\right]=f^e.$$

The equilibrium can be obtained by solving this system of equations numerically. The algorithm is constructed in a very similar way as the one used for the solution of the symmetric economy. To find the optimal effort level e_i we iterate over the full model to find the effort level which maximizes the government's objective function.

Appendix D: Remoteness

Table 2.2 lists the worlds least and most remote countries ranked in terms of $TradeDist$. $Tradedist$ for country i is calculated as:

$$TradeDist_i = \frac{\sum dist(km)_{i,j} * TotalExports_j}{\sum TotalExports_j},$$

where $dist(km)_{i,j}$ is the distance between country i and j, and $TotalExports_j$ is the Total Exports in USD in year 2000 of country j.

$GDPDist$ for country i is calculated as:

$$GDPDist_i = \frac{\sum dist(km)_{i,j} * GDP_j}{\sum GDP_j},$$

where $dist(km)_{i,j}$ is the distance between country i and j, and GDP_j is the Total GDP in USD in year 2000 of country j.

For the purpose of table 2.2 we also calculate the unweighted distance, or average geographical distance, $GEODist$ as:

$$GEODist_i = \frac{\sum dist(km)_{i,j}}{N},$$

where $dist(km)_{i,j}$ is the distance between country i and j, and N is the number of countries

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in the sample.

Table 2.2: Distance

The most and least remote countries sorted by TradeDist			
Country	**Trade Dist**	**GDP Dist**	**GeoDist**
New Zealand	14,804	13,730	13,265
Australia	13,557	12,917	12,656
Tonga	13,374	12,608	13,153
Fiji	13,070	12,367	12,998
Vanuatu	12,858	12,221	12,796
Netherlands	4739	5983	6693
Germany	4752	5990	6656
Belgium	4762	6008	6671
Denmark	4781	5942	6720
Luxembourg	4788	6028	6632

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Chapter 3

The Impact of Trade Agreements for LDCs: The Case of the South Asian Free Trade Agreement

Joint work with Oskar Nelvin

3.1 Introduction

The South Asia Region, comprising Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka and Afghanistan, is the world's largest regional bloc in terms of population, being home to almost 23 percent of the total world population. It is also one of the world's poorest regions. Despite rapid economic growth in recent years, South Asia accounts for as little as 3% of total world GDP. In terms of international trade, the region is becoming an increasingly important player and is evolving as a major exporter of labor intensive goods such as textiles and jewelry. The intraregional trade share, at 4%, is however extremely low by international standards, leading some commentators to describe it as the most poorly integrated region in the world.

It is therefore not surprising that the signing, in 2004, of the South Asian Free Trade Agreement (SAFTA) has spurred a lively debate among international policy makers and academics. The treaty is set to almost completely eliminate tariffs within the region for a

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large number of product categories, and was implemented in 2006.

On the one hand, critics have argued that SAFTA has little trade creating potential, and risks being heavily trade diverting. This argument has been based on the following four points: Firstly, the pre-treaty level of intraregional trade in the region is very low, indicating that the SAFTA countries are unlikely to be 'natural trading partners' (see for example Panagariya (2007)).[1] Secondly, strong non-tariff barriers within the region, including corruption, poor infrastructure and heavy delays at border points, constitute a serious impediment for intraregional trade.[2] Tariff reductions under SAFTA are therefore unlikely to increase trade flows to any larger extent. Thirdly, all South Asian countries maintain very high tariffs towards the rest of the world (Pitigala (2005)). Fourthly, the treaty incorporates a so called negative (or sensitive) list feature, which provides countries with a large amount of discretion in deciding which products should, or should not, be subject to tariff reductions under the treaty. Protectionist governments are likely to protect the relatively uncompetitive industries, thereby excluding from tariff reductions exactly those sectors in which trade creation is likely to occur.

Proponents of the treaty have on the other hand argued that the implementation of the SAFTA treaty is likely to lead to significant trade creation. A recent ADB/UNCTAD (2008) report finds "…an enormous potential for intraregional trade among SAFTA economies." This assessment is based primarily on observed recent improvements in complementarities between the product baskets produced by South Asian countries. The shift in emphasis from production of agriculture goods to manufacturing, it is argued, has greatly improved the regions potential for intraregional trade. Rapid growth in intraindustry trade is seen as another indicator of the regions potential as an integrated trade bloc. In addition, it is argued, SAFTA could work as a commitment tool, fostering improved policy credibility in the region by locking in uniform trade and investment policies.

In the current chapter we aim at contributing to this debate by formally estimating the treaty's impact on intraregional trade flows, as well as how it has affected the region's

[1] According to the natural trading partner hypothesis, welfare gains from trade integration are increasing in the pre-integration regional trade proportion (Lipsey (1960)). However, Iapadre (2000) argues that the intraregional trade share is a poor measure of regional integration and hard to compare across regions. He argues instead for the use of regional bias. The regional bias in trade within the Sout Asia region is similar to regional bias within for example the EU or ASEAN.

[2] See for example Banik and Gilbert (2008) and Ahmed and Ghani (2007).

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trade with the rest of the world. Previous papers on SAFTA have in most cases been written prior to the actual implementation of the treaty and have therefore been unable to provide any sort of post implementation assessment. We, on the other hand, have access to post-treaty data and can therefore estimate actual trade creation and diversion[3] resulting from the first wave of tariff reductions. In addition, we provide relatively in-depth descriptive statistics on the extent of trade protection provided under the treaty's negative list provision. We do this firstly as the negative provision plays a direct role in our estimation strategy and secondly because this is an area that has been largely ignored in the previous literature.

The chapter also makes a couple of relatively minor methodological contributions. The literature on regional trade integration has traditionally relied heavily on gravity equations. Though this methodology has some empirical support, it has been criticized by several authors (see for example Balgati (2001)). When gravity equation models are used it is often very hard to distinguish between regional bias in trade and trade creation resulting from the formation of a regional Preferential Trade Agreement (PTA). Estimates are further likely to suffer from endogeneity. In an attempt to deal with these issues we make use of the fact that, in the case of SAFTA, some goods have been excluded from the treaty. This allows us to estimate both trade creation and diversion using a difference in difference estimator. Though we think that this is an improvement on the standard literature, we still fall short of a full causal identification, as this would require the negative lists to be constructed randomly. We also depart from the standard literature in that we use a quasi maximum likelihood estimator instead of OLS with log-transformations. OLS with log-transformation has been shown to introduce significant bias under presence of heteroskedasticity (Santos Silva and Tenreyro (2006)).

According to our estimates, the first wave of tariff reduction under SAFTA has give rise to significant trade creation. Intraregional trade flows for eligible products have increased, on average, by as much as 35-40%. This figure is comparable to Cheng and Wall (2005)'s estimates for MERCOSUR and significantly higher than estimates for other trade blocs

[3]Trade creation occurs when the lowering of tariffs within the PTA induces agents to switch suppliers from an inefficient producer in the home country, to a more efficient foreign producer based within the PTA. Trade diversion, on the other hand, occurs when the lowering of tariffs induces agents to switch suppliers from an efficient producer based outside the PTA, to a less efficient producer based within the PTA.

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such as the EU and NAFTA. Certain sectors have benefited more than others, and in line with the predictions of ADB/UNCTAD (2008), we find that increased trade in agriculture and textile products have been one of the main drivers of the results. We do not find any strong evidence of trade diversion. In fact, our basic estimates indicate that the SAFTA treaty, somewhat surprisingly, has increased trade with the rest of the world. Though this result, sometimes called Open Block effects (Eicher, Henn and Papageorgiou 2008)), is not unknown in the literature, it is hard to explain theoretically. In the case of SAFTA however, the implementation of the treaty has been accompanied by significant reductions in MFN tariffs towards outside trading partners. When we control for tariffs the Open Block effects are greatly diminished and with some specifications disappear altogether.

Though the SAFTA treaty has so far been largely successful in spurring intraregional trade, substantial room for improvement still exists. In order to boost trade creation, and limit the risk of trade diversion, the scope of the negative list provision should be greatly reduced. One possibility would be to introduce rules that regulate the total trade value that can be subject to exemption. Such rules would discourange countries from putting relatively more important intraregional trading products on the negative list.

The remainder of the chapter is organized as follows: In Section 3.2 we provide key statistics and an overview and of trading relationships in South Asia. Section 3.3 provides the historical background to the treaty and describes its most important features. In section 3.4 we take a closer look at the negative list provision and discuss its implications. Section 3.5 provides a brief overview of the structure of external tariffs in the SAFTA countries. In section 3.6 we discuss trade creation and trade diversion and provide estimates for SAFTA. Section 3.7 concludes.

3.2 The South Asia Region

Though growing rapidly, South Asia is still a small player in international trade. Since 2000 the region's international trade share has been steadily increasing from around 1.2% in 2000 to 2.2% in 2008, but it is still very small compared to most other trading blocks.[4] Textiles and Textile Articles are by far the regions top export products, making up 29% of

[4]The trade data is obtained from the COMTRADE database.

total exports, followed by Pearls, Precious Stones and Metals (13%) and Mineral Products (11%). The most important import goods are Mineral Products, representing 31% of total imports, followed Machinery and Mechanical Appliances (16%) and Pearls, Precious Stones and Metals (13%).[5] The importance of Precious Stones and Metals on both the import and export side illustrates India's strong position in Gem and Jewelry[6] industry.

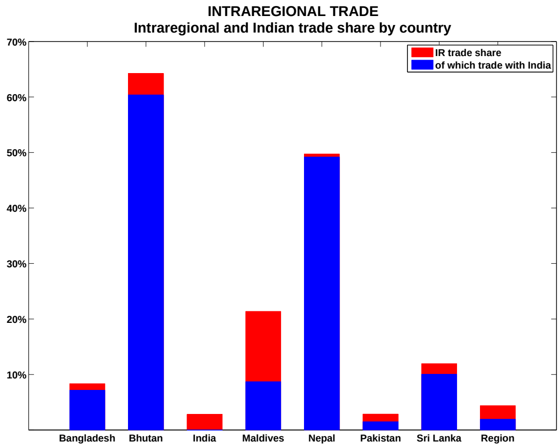

Figure 3.1: Intraregional trade (Source Comtrade, 2000-2008 averages)

Europe is the regions most important trading partner, making up around 16% of total trade[7], followed by North America (9%). The region also has strong trade links with Japan and China. As pointed out in the introduction, as a whole, the South Asian countries trade relatively little with each other. The intra-regional trade share is a mere 4%. However, as illustrated in Figure 3.1, some countries are heavily dependent on intraregional trade. For example, Nepal and Bhutan both rely on the region for over 50% of their trade. Figure 3.1 also illustrates India's dominance in intraregional trade relationships: Overall 45% of trade between South Asian countries take place with India as the importer or exporter. The equivalent figure for Nepal is 99% and for Bhutan 94%. India's dominance is based on two factors. Firstly, it is by far the regions largest economy. Secondly, the country occupies a central geographical position. In fact, all countries in the region, with the exception of Afganistan, boder India, and for most countries India constitutes the only regional neighbour.

In terms of intraregional trade, Textiles and Textile Articles is the most important product

[5]All numbers as an average 2000-2008.
[6]For example, India's market share in diamonds is 55% in terms of value and 95% in terms of pieces.
[7]Total tade is Imports plus Exports.

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category, making up 18% of total intraregional trade flows, followed by Agriculture (15%) and Chemical products (13%).

3.3 SAFTA: History and Background

The South Asian Free Trade Agreement is the most recent, and by far the most ambitions, in a series of treaties aimed at promoting integration within the South Asian region.[8] The treaty was signed by seven founding members[9] in Pakistan in January 2004, and came into force in January 2006. The first wave of tariff reductions took place in July of the same year. The schedule for tariff reductions consists of two stages, as shown in Appendix I, Table 3.3, and gives the least developed countries of the region (LDCs)[10] more time to reach the goal of tariffs between 0 and 5 percent.

A priori all products are destined for tariff reductions. However, the principle of a negative (or sensitive) list applies, which means that some products can be excluded from the liberalization process. Each member country is allowed to put up to 25 percent of the total number of products at a 6-digit HS classification on its negative list. This substantial amount of protected goods is to be gradually reduced over the next years[11]. Section 3.4 provides a more in-depth description of the negative list provision of the treaty.

In addition to the negative list, products have to fulfill the rules of origin (RoO) restrictions in order to benefit from tariff reductions. To comply with RoO, goods have to undergo substantial manufacturing process in the member countries before being exported. Sufficient transformation is achieved by the twin criteria of change of tariff heading at a 4-digit HS level and a domestic value added content of 40% for non-LDCs, 35% for Sri Lanka and 30% for LDCs. The SAFTA treaty also establishes a mechanism for compensation of

[8]The first step towards further regional integration in South Asia was taken in 1985 with the creation of the South Asian Association of Regional Cooperation (SAARC). SAARC aimed at fostering regional economic cooperation, as well as promoting collaboration on social and cultural issues, but had limited implications in regards to trade relations. A second step was made in 1993, with the signing of the South Asian Preferential Trade Agreement (SAPTA) by all SAARC members. The treaty was implemented in 1995 and its main objective was the creation of a multilateral framework for region-wide trade integration. However SAPTA suffered from too restrictive rules of origin, lack of trade facilitation measures and trade preferences were granted only on a product-by-product basis. The agreement therefore had limited success in fostering intraregional trade (Baysan, Panagariya and Pitigala (2006)).

[9]Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. Afghanistan joined the FTA as eighths member in 2007.

[10]LDCs: Afghanistan, Bangladesh, Bhutan, Maldives and Nepal.

[11]A first revision round took place in 2009.

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customs revenue loss and technical assistance for LDCs.

3.4 The Negative List

Having provided a basic overview and background to SAFTA we will now take a closer look at the negative list provision of the treaty. The negative list is arguably one of the most problematic features of the SAFTA treaty. By leaving governments free to choose how to allocate tariff reductions across sector groups, the treaty provides significant scope for governments to protect uncompetitive industries while opening up for trade in sectors where the country already has a regional competitive edge. If countries choose to negative the list product categories in which they have a regional comparative disadvantage, very little trade will be created.

As explained above, the SAFTA treaty allows member countries to exclude from tariff reductions a total of 25% of all product lines on the 6-digit (HS classification) level. When the SAFTA treaty was signed in 2005 it was agreed that a revision of the list would take place every four years, and indeed revised negative lists have been published by the SAARC secretariat in 2009. However, a clear agenda about the extent of reductions over the next years has never been set.

The actual number of categories excluded differs significantly between member countries. While most countries keep more than 20 percent of all items on the negative list, India and the Maldives protect around 15 percent and Bhutan only around 3 percent.[12] The proportion of product categories included on the negative list is however a poor measure of how important these lists are as an impediment to trade. Firstly, as discussed above, the mere fact that products can be excluded is problematic if this is done to protect industries in which complementarities in comparative advantages exist. Secondly, 25% of product categories does not necessarily correspond to 25% of import flows. By designating important import products as negative listed, and leaving little traded, or not at all traded, items on the positive list, protectionist member countries can effectively exclude a large proportion of trade from the treaty.

[12]Bangladesh, India and Nepal maintain two separate lists, one for non-LDC and one for LDC members. In all three cases the negative list pertaining to LDCs feature a marginally lower number of product categories. Details can be found in Table 3.4, Appendix A.

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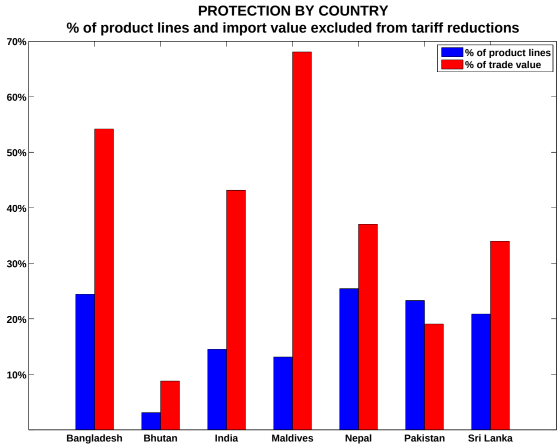

Figure 3.2: Protection by country (Source Comtrade, 2000-2005 averages)

Figure 3.2 illustrates this. We calculate the proportion of total imports (average from 2000 to 2005) excluded from tariff reductions due to the negative list. Though India has placed only around 15% of product categories on its negative list, these represent 43% of the country's intraregional imports, the equivalent figure for Bangladesh is 54% and for the Maldives 68%. Overall, approximately 43% of total intraregional imports of SAFTA members pertain to product categories excluded from tariff reduction. It is clear that with the exception of Pakistan, all countries in the region have opted to place relatively important import products on the negative list, while eliminating tariffs on less central products. As the product lines which pre-treaty were the most traded also are likely to be the ones in which the member countries are natural trading partners, this practice greatly reduces the scope for trade creation.

The next step is to look at which industries the member countries' have chosen to exclude. Naturally this differs from country to country; however, we can present a broad overview. We calculate the proportion of product lines, as well as the proportion of trade value, pertaining to negative list items on average for all SAFTA countries for 17 HS Sector Categories[13]. Agriculture products, represented by sector categories A and B, are to a large extent excluded from the treaty. In these categories between 70% and 85% of pre-treaty trade took place in products which post treaty are not be subject to tariff reductions. For individual countries the figures are even higher, Sri Lanka has for example excluded 96% of its vegetable imports from tariff reductions. Other heavily protected industries

[13]See Appendix B for a more detailed description of these Sector Categories.

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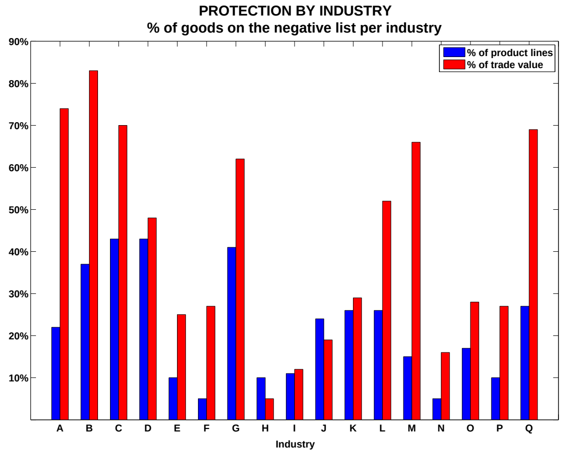

Figure 3.3: Protection by Industry (Source Comtrade, 2000-2005 averages)

include Plastics and Rubber (G), Footwear (L), Articles of Stone (M) and Transport Equipment (Q).

What can we say about how product categories have been selected for negative list inclusion? In the introduction to this section, we argued that the negative list provision would be the most harmful if countries negative listed products in which they have a regional competitive disadvantage, while reducing (or eliminating) tariffs on product categories in which they already have regionally competitive industry. Naturally, uncompetitive industries have more to fear from import competition, and are therefore likely to lobby harder for negative listing. The question is to what extent such demands have been accommodated.

If they have, we should be able to observe a negative correlation between negative list inclusion and some measure of relative regional comparative advantage. However, as comparative advantage per se is not observable, testing for such a correlation not straight forward. We therefore have to resort to what in the literature is called Revealed Comparative Advantage (RCA) (Balassa 1965). RCA uses observed trade patterns to deduce patterns of comparative advantage[14]. Note however that as observed trade patterns are partly a result of existing levels of trade protection, regressing trade protection on RCA gives rise to significant endogeneity problems. The results presented below should therefore be interpreted with caution.

We calculate average regional RCA for 2000-2005 on a 6-digit product category basis (see

[14]The higher the RCA rating, the stronger is the country's reveled regional comparative advantage in the relevant product line. An RCA rating of one implies a neutral degree of comparative advantage.

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Appendix C for calculation) and run a probit on negative list inclusion country by country. Estimates are presented in table 3.6, Appendix C. Overall the results are mixed. The larger countries in the region, especially India, do indeed seem to bias their negative lists towards products in which they have a comparative disadvantage, thus limiting the potential for trade creation. In India's case, an increase in the RCA index by 1, is associated with a 50% decrease in the probability of negative list inclusion. For Bangladesh and Pakistan the estimates are however much smaller, and for the smaller countries reversed. I.e. the smaller countries in the region, especially Sri Lanka, seem to favor including products for which they have a comparative advantage on the negative list, thus limiting the scope of the negative list contributing to trade diversion. However, as stated above, these estimates should be interpreted with caution.

3.5 Tariff structure

To analyze the impact of tariff reductions under SAFTA, we need to understand the tariff structure in place prior to the treaty, as well as the changes in external tariffs adopted alongside of the treaty.

The South Asian countries[15] have traditionally maintained high levels of tariffs across product categories, and this has been one of the main arguments put forward against the formation of a regional PTA. However, though tariff levels in South Asia in general, and India in particular, are still relatively high by international standards, they are on a clear downward trend. Figure 3.4 shows an unweighted average of SAFTA area MFN tariffs between 2000 and 2009.[16] Since we are interested in analyzing the potential for trade diversion stemming from the SAFTA treaty we distinguish between negative and positive list products. As negative list products are excluded from the treaty, it is the level and the adjustment of tariffs in positive list item that should be our main concern.

The first thing to note in Figure 3.4 is that negative list tariffs are on average 50-70% higher than tariffs on positive list items. This is not only true on average, but also for

[15] With the exception of Afghanistan and Bhutan, all nine SAFTA members are also members of the WTO.

[16] Data WTO. We assume that if a country does not report tariffs for a specific year, that means that tariffs were unchanged from the previous year. Bhutan and Afganaistan have been excluded since we do not have reliable tariff data for these countries.

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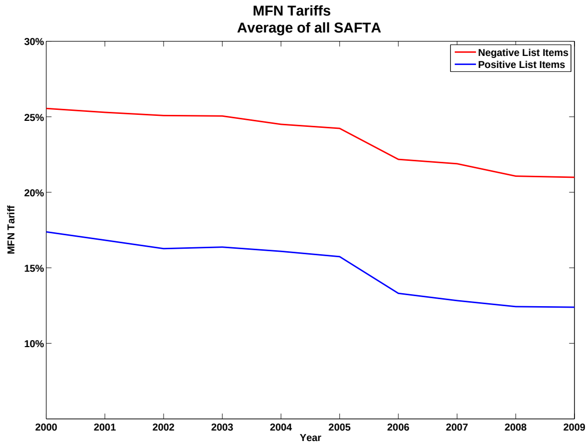

Figure 3.4: MFN tariffs (Source WTO)

each country individually. The product lines that the SAFTA countries have decided to protect from regional competition is the same as those that enjoy strong protection from competitors outside the region. The second thing to note is that MFN tariffs, on average, have been reduced significantly over the period. The implementation of SAFTA has hence coincided with substantial tariff reductions with respect to the rest of the world.

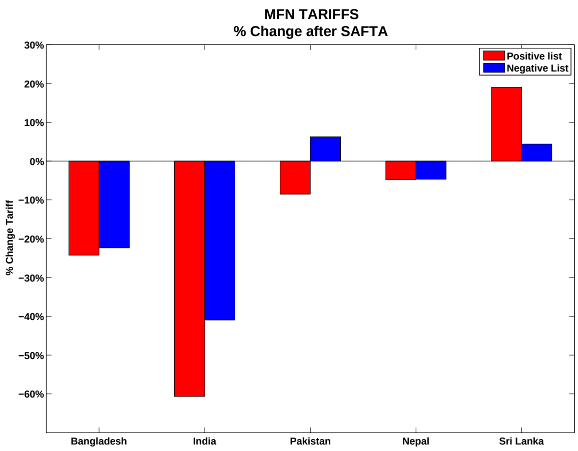

Figure 3.5: Change in MFN tariffs (Source WTO)

Figure 3.5 provides a closer look at the magnitude of tariff reductions by country over the period. We calculate the percentage change in MFN tariffs between the pre- and post SAFTA period for negative- and positive list items respectively.[17] Pre SAFTA tariffs are calculated as average MFN tariffs for the years 2000-2005, post SAFTA tariffs are

[17]Data WTO. The Maldives, Afghanistan and Bhutan have been excluded due to lack of reliable data.

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calculated as average MFN tariffs for the years 2006-2009. The average reduction in tariffs noted in figure 3.4 is clearly to a large extent driven by Indian tariff reductions. Indian tariffs were also the highest in the pre SAFTA period, averaging around 38% for negative list items and 29% for positive list items, compared to an average of 12.5% and 22.5% respectively for the rest of the region. However, all countries in the region with the exception of Sri Lanka have reduced tariffs. An important observation is that tariffs have been reduced to a larger extent for positive list items than for negative list items. Pakistan has in fact increased tariffs on negative list items, while reducing them for positive list items. This emphasis of reducing tariffs for product lines eligible for tariff reductions under SAFTA should ease concerns about a trade diverting outcome of the treaty.

In the next section we will move on to formally testing trade creation and trade diversion stemming from the first wave of tariff reductions under SAFTA.

3.6 Trade Creation and Trade Diversion

The welfare impact of PTAs on member and non member countries has long been an important issue for policy makers and economists, especially given the large increase in the number of such treaties in recent years. In theory the welfare effect of the creation of a PTA is ambiguous as it represents a move from one second best equilibrium to another second best equilibrium. Viner (1950) suggested an approach to identify welfare improving and welfare deteriorating PTAs. He argued that PTAs that are trade creating are beneficial, whereas those that are trade diverting are detrimental to welfare.

Trade creation occurs when the lowering of tariffs within the PTA induces agents to switch suppliers from an inefficient producer in the home country, to a more efficient foreign producer based within the PTA. Trade diversion, on the other hand, occurs when the lowering of tariffs induces agents to switch suppliers from an efficient producer based outside the PTA, to a less efficient producer based within the PTA. Trade creation therefore implies that the PTA gives rise to more trade between member countries, wheres trade diversion implies that trade is decreased with countries that are not members of the PTA.

More recent research has shown that trade diversion is not necessarily detrimental for welfare (for an overview of the literature see Cheong and Wong (2009)). In general Viner's

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theory holds under perfect competition. However, under imperfect markets, gains from trade diversion can occur as profits are shifted from non PTA member suppliers to PTA member suppliers. Having said that, the estimation of trade creation and diversion still remains the workhorse for determining the welfare effects of individual PTAs.

In the following section we will estimate trade creation and diversion stemming from the first wave of tariff reductions under SAFTA. We do this to provide a first evaluation of the success of the treaty.

3.6.1 Estimation Strategy and Results

The standard literature on regional PTAs has relied almost exclusively on cross sectional gravity models for the estimation of trade creation/diversion. In such models, the log of aggregated trade values are typically regressed on a set of gravity controls, while trade creation and diversion are estimated by the inclusion of dummies for regional PTAs. As pointed out by several authors (for an overview see Baltagi (2001) or Egger (2005)) gravity equations suffer from a number of both theoretical and empirical problems, and generally lead to highly biased estimates. For example, cross sectional models cannot distinguish between trade creation resulting from the creation of a PTA, and regional bias in trade. If the member countries of a PTA had strong trade links already before its implementation (which might have been a reason for the creation of the PTA in the first place), the estimates for trade creation are likely to suffer from a heavy upward bias. In the current chapter we will therefore instead rely on panel data estimation in a framework similar to that suggested by Cheng and Wall (2005).

Like in the standard literature, Cheng and Wall (2005) regress the log of aggregated trade values on a set of gravity controls, and include dummies to estimate trade creation/diversion. However, instead of using cross sectional data, Cheng and Wall (2005) use a panel data set with period- and country pair fixed effects. The country-pair effect picks up omitted variables that are cross-sectionally specific but remain constant over time. Such variables could include distance, common culture/language, contiguity etc. Trade creation and diversion can then be estimated by the inclusion of dummies for PTA membership. The country pair fixed effects eliminate the endogeneity problem caused by endogenous formation of PTAs and regional bias present in cross sectional models. This

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type of difference estimator is however not necessarily very robust. The problem is that it only picks up the change in total trade flows before and after the introduction of the treaty, without using any appropriate controls. Any changes in bilateral trade relationships, apart from the introduction of the PTA, are supposed to be captured by the period fixed effects, which are common for all trading partners. To solve this problem we try to improve upon Cheng and Wall (2005)'s approach by using a difference in difference estimator. We can do this as the negative list provision of the treaty effectively excludes almost half of trade flows from tariff reductions, and thereby provides us with an appropriate set of controls. By using within region controls we can also estimate trade creation on within region trade data.

We also depart from the mainstream gravity equation literature by estimating our model using pseudo-maximum-likelihood (PML) rather than, as is the industry standard, using a log linearized model estimated by OLS. This means that we can use raw trade values, rather than trade values in log form. Santos Silva and Tenreyro (2008) show that log-linearization lead to severely biased estimates under the presence of heteroscedasticity. In addition, by using PML and non-log linearized trade data, we do not have to worry about potential bias introduced due to the large number of zero value observations.[18]

One drawback with our difference in difference methodology is that it does not allow us to estimate trade creation and trade diversion in a single model. Doing so would require the estimation of two separate difference-in-difference-in-difference estimators, and significantly complicate the interpretation of our results. Instead we create separate data sets, and run separate models for estimation of trade creation and diversion. It should also be noted, that even though we do believe that we are improving upon the methodologies traditionally used in the literature, we still fall short of full causal identification. The assignment of product lines to the respective countries negative and positive lists should be seen as the outcome of a political economy model, rather than as an outcome of a random assignment. How is this likely to effect our estimates? Earlier in the chapter we have argued that the excluded product categories are likely to be the ones for which trade creation is the most likely to occur. If this is the case our estimates would be biased downwards, and should be considered a lower bound for potential trade creation.

[18] When log-linerization is used zero trade values are either ignored completely, or treated by adding 1 to all trade values before taking logs.

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Estimation of trade creation

We estimate within SAFTA trade creation using two separate data sets. The first dataset contains data on intraregional imports for each SAFTA member on the 6-digit product category level between 2000 and 2008. The second dataset again contains data on intraregional imports for the same period, but instead of using the 6 digit level, we have aggregated the data to yearly observations of imports in positive and negative list items respectively. The disaggregated dataset allows us to look at individual industries separately, while the aggregated dataset is less likely to suffer from measurement errors and potential errors related to product classification concordance. The aggregated dataset is also, as we will see below, more easily comparable to the dataset used for estimation of trade diversion.

We collect data on yearly intraregional trade flows between 2000-2008 from the UN Comtrade database. Using the HS-96 classification, data is available for all years for India, Maldives and Sri Lanka. Data is available for Bangladesh between 2000 and 2007 and for Pakistan between 2003 and 2008. For Bhutan we only have data for 2005 and 2008. As we have only pre-treaty data for Nepal, and no data for Afghanistan, we are forced to exclude both these countries from our analysis. The disaggregated dataset is made up of 263,338 observations of bilateral 6-digit category trade flows, of these 52.8% are zero value observations. The aggregated dataset set is made up of 520 observations of bilateral negative and positive list trade flows, of these 10% are zero value observations. We further collect data on population and GDP from the WorldBank World Development indicators. The respective countries negative lists are obtained form the SAARC Secretariat and from national departments of commerce.

The following model is estimated on both datasets:

$$Y_{i,j,c,t} = \alpha_0 Z_{i,j,c,t}^{\beta_2} \varepsilon^{\alpha_t D_1 + \alpha_{i,j,c} D_2 + \alpha_{positive,i,c} D_3 + \alpha_{SAFTA,t} D_4 + \beta_1 (D_3 D_4)}, \tag{3.1}$$

where $Y_{i,j,c,t}$ is the import value of country i from country j in commodities c at time t, c being either a 6-digit product line or the aggregated value of negative or positive list item imports. α_0 is the proportion of the intercept that is common to all years and trading pairs, α_t denotes the year-specific effect common to all trading pairs and $\alpha_{i,j,c}$ is the time

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in-variant country-pair effect. The country-pair effect is constructed differently for the two datasets. In the aggregated dataset it is a set of dummies for each country pair. In the disaggregated dataset it is instead a set of dummies representing each country-industry pair, where industries are aggregated to the 2 digit level. $\alpha_{positive,i,c}$ is a dummy equal to 1 if the respective commodity group is listed on the positive list, i.e. is eligble for tariff reductions under SAFTA. $\alpha_{SAFTA,t}$ is a dummy equal to 1 if the observation is drawn from the period after the first wave of tariff reductions, i.e. 2006, 2007 and 2008. $Z_{i,j,c,t}$ is the 1*k vector of gravity controls.

Table 3.1: Trade Creation - Estimation results

	(1) **6-figure**	**(2)** **6-figure**	**(3)** **AG0**
Safta*PosList	0.37*	0.39**	0.41**
	(0.16)	(0.09)	(0.15)
Safta	-4.6**	0.1	-0.74
	(1.90)	(0.13)	(0.6)
PosList	-0.84**	-0.94**	0.29**
	(0.08)	(0.07)	(0.085)
Time FE	YES	NO	YES
Industry-Partner FE	YES	NO	
Trading pair FE			YES
R-square	0.26	0.1	0.95
N	263,339	263,339	520

* Significant at 5% level, ** Significant at 1% level.
Robust standard errors.

If SAFTA has had a positive impact on trade flows, trade volumes should increase in products on the positive list, but we should see no impact on those on the negative list. β_1, the coefficient for the interaction term $\alpha_{positive} * \alpha_{SAFTA}$, tests for the difference in difference between trade in negative list and positive list commodities before and after the implementation of the treaty. A positive and statistically significant value for β_1 should hence indicate that the treaty has increased intraregional trade flows. Note that β_1 can be interpreted both as a parameter for trade creation due to SAFTA and as a parameter for trade destruction due to the existence of a negative list. Hence, it does not only tell us

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something about what has happened so far, but also about the potential benefits in terms of trade creation that could be achieved by reducing the number of items on the negative list.

Table 3.1 summarizes the results. Columns (1) and (2) present results obtained using the disaggregated dataset (with and without fixed effect, FE), columns (3) and presents results obtained using the aggregated dataset.

According to our estimates SAFTA has increased intraregional trade flows for eligible goods by, on average, as much as 40%. This figure is comparable to Cheng and Wall (2005)'s estimates for MERCOSUR and significantly higher than their estimates for other trade blocs such as the EU and NAFTA. The results are similar regardless of specification and dataset used. Despite the significant non-tariff barriers to trade present in the region, the the implementation of the SAFTA treaty has led to significant increases in intraregional trade, and that in a relatively short period of time.

The negative coefficient on PosList in the disaggregated dataset simply reflects, as discussed in section 3.4, that all countries have decided to place relatively important product categories on the negative list, and left less important ones on the positive list. The fact that the sign on the coefficient changes when we move to the aggregated dataset simply reflects that total trade is larger in positive list products as they on average represent more than 75% of product categories.

We can also estimate trade creation by industry. Figure 3.6 shows estimates for trade creation by industry for the top five intraregional trading sectors. Together they represent approximately 70% of intraregional trade (average 2000-2008). The corresponding results table can be found in Appendix D. Trade creation seems very much driven by the most important intraregional trading products. According to our estimates SAFTA has almost doubled trade in Textile and Textile Articles (K), also Agricultural products (A+B), and Chemical Products (F) have enjoyed large increases in trade volumes due to the implementation of SAFTA. The fact that the major trading products are the ones driving trade creation is not very surprising. When trade is liberalized one would expect trade to expand mainly within those industries where strong trading relationships already exist.

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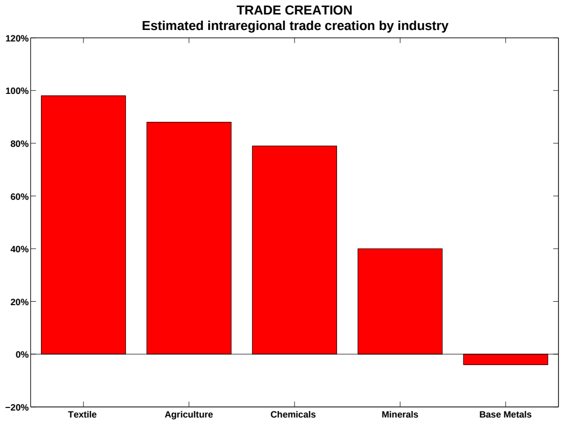

Figure 3.6: Trade creation by industry

Estimation of trade diversion

For the estimation of trade diversion we collect data on extra-regional bilateral import flows, that is imports to all SAFTA countries from all countries outside the SAFTA region. We limit ourselves to constructing a dataset aggregated to the level of import flows in negative and positive list items.[19] The aggregated dataset is made up of 12,334 observations, of these 29% are zero value observations. We have also collected data on MFN tariffs from the WTO.

Again, we estimate model (3.1). If SAFTA has been trade diverting, we would expect imports in positive list items from countries outside the SAFTA area to have been reduced as a result of the treaty. By the same reasoning as for the estimation of trade creation, we would therefore expect β_1 to be negative if the SAFTA treaty has been trade diverting with respect to the rest of the world.

Table 3.2 summarizes the results on trade diversion. At a first inspection the base case estimates in column 1 are quite surprising. The coefficient on β_1 is actually positive, indicating that the implementation of the SAFTA treaty has increased trade with the rest of the world. We are hence observing interregional trade creation instead of trade diversion. This result, called Open Block effects (Eicher, Henn, and Papageorgiou (2008)), is not unknown in the literature on PTAs , but is hard to explain with robust theory.

[19]Collecting data on all trading partners on a 6 digit level would result in a dataset of approximately 30 million observations. This is significantly more than our software can handle.

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Table 3.2: Trade Diversion - Estimation results

	(1) **AG0**	**(2)** **AG0**	**(3)** **AG0**
Safta*PosList	0.22*	0.10	-0.09
	(0.11)	(0.11)	(0.12)
Safta	0.11	-0.11	0.32
	(0.25)	(0.24)	(0.33)
PosList	1.63**	1.50**	1.79**
	(0.07)	(0.08)	(0.09)
Tariffs		-0.38**	-0.37**
		(0.08)	(0.08)
Time FE	YES	YES	YES
Trading pair FE	YES	YES	YES
Excl. Bang,Bhut,Mal	NO	NO	YES
R-square	0.94	0.94	0.94
N	12,334	11,784	7,614

* Significant at 5% level, ** Significant at 1% level.
Robust standard errors.

However, as noted in section 3.5, the introduction of the SAFTA treaty has coincided with significant reductions in MFN tariffs for most countries. If these reductions had been uniform across negative and positive list items, they would have had no impact on our estimates. However as pointed out, they were not. Instead, trade liberalization has targeted mainly positive list items. We do not know if this has been done as a conscious effort to counter trade diversion or for some other reason, but these targeted reductions might explain the observed result. We therefore introduce log tariffs as a control in our model. The results are listed in column 2. β_1 is more than halved and is now no longer statistically significant. It seems as if a large part of the Open Block effects stem from tariff reductions.

As mentioned in section 3.5 we only have access to limited tariff data from Bangladesh, Maldives and Bhutan. We therefore re-estimate the model excluding these countries. The results are presented in column 3. The estimate for β_1 is now negative at 9%, i.e. we are observing trade diversion.[20] Note however that this result is not even close to being

[20]A reduction in outside trade by 9% represents a significantly larger volume of trade than the estimated increase in regional trade of 41%. In terms of volume the SAFTA treaty would therefore have been strongly

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statistically significant on any reasonable level.

To conclude, our estimates indicate that at least the first wave of tariff reductions under SAFTA could have given rise to significant trade diversion, had they not been accompanied by significant reductions in tariffs towards the outside world. However, by reducing tariffs on positive list products such an outcome has been avoided.

3.7 Conclusion

The current chapter provides an overview and analysis of the SAFTA treaty. We formally estimate trade creation and trade diversion stemming from the first wave of tariff reductions and find strong evidence of intraregional trade creation. According to our estimates the SAFTA treaty has increased trade between the member countries (in eligible goods) by, on average, as much as 40%. This is quite a high figure compared to estimates for other PTAs. Trade creation seem to have been particularly high in the region's most important trading goods, such as textiles and agricultural products. According to our estimates, trade in eligible textile products has increased by almost 100% and trade in agriculture products by almost 90% as a result of the implementation of the treaty.

Trade diversion appears to have been limited. However, this is mainly a function of the fact that the implementation of the treaty has coincided with significant reductions in external tariffs. Had these tariff cuts not taken place, our most pessimistic estimate indicate that trade diversion could have been quite large, around 9% of extraregional trade. This figure is however not statistically significant, nor robust to model specification.

The negative list provision of the treaty severely limits its scope and constitutes one of SAFTA's most problematic features. Despite the fact that member countries are limited to assigning 25% of 6-digit product categories to their negative list, these lists represent over 42% of total trade flows.

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trade diverting (the net effect would have been a reduction in trade volumes of around 8%).

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Appendix A: The SAFTA treaty

Table 3.3 provides an overview of the timing of the implemntation of the SAFTA treaty. Table 3.4 lists the number of 6 digit product categories excluded from tariff reductions by country.

Table 3.3: The SAFTA treaty

	Non-LDCs	LDCs
Phase 1	Duration: 2 years. Existing tariff more than 20%: reduction to a maximum tariff of 20%. Existing Tariff less than 20%: annual tariff reduction by 10%	Duration: 2 years. Existing tariff more than 30%: reduction to a maximum tariff of 30%. Existing Tariff less than 30%: annual tariff reduction by 5%.
Phase 2	Duration: 5 years for India and Pakistan, 6 years for Sri Lanka. All tariffs have to be reduced to levels between 0 and 5%, in equal annual installments with at least 15% reduction annually.	Duration: 8 years. All tariffs have to be reduced to levels between 0 and 5%, in equal annual installments with at least 10% reduction annually.

Table 3.4: The Negative List

	Total Number of products on the Negative List		**Coverage as % of 6-digit HS product line**	
Country	**Non-LDC**	**LDC**	**Non-LDC**	**LDC**
Afghanistan	1072		20.52%	
Bangladesh	1253	1249	23.99%	23.91%
Bhutan	158		3.02%	
India	863	742	16.52%	14.20%
Maldives	671		12.84%	
Nepal	1336	1300	25.57%	24.89%
Pakistan	1190		22.78%	
Sri Lanka	1067		20.42%	

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Appendix B: HS Sector Categories

Table 3.5 lists the HS Sector categories used in this chapter together with their respective category code.

Table 3.5: HS Sector Categories

Category	**HS-Code**	**Product description**
A	01-05	Animals & Animal Products
B	06-14	Vegetable Products
C	15	Animal Or Vegetable Fats
D	16-24	Prepared Foodstuffs
E	25-27	Mineral Products
F	28-38	Chemical Products
G	39-40	Plastics & Rubber
H	41-43	Hides & Skins
I	44-46	Wood & Wood Products
J	47-49	Wood Pulp Products
K	50-63	Textiles & Textile Articles
L	64-67	Footwear, Headgear
M	68-70	Articles Of Stone, Plaster, Cement, Asbestos
N	71	Pearls, Precious Or Semi-Precious Stones, Metals
O	72-83	Base Metals & Articles Thereof
P	84-85	Machinery & Mechanical Appliances
Q	86-89	Transportation Equipment
R	90-97	Miscellaneous

Appendix C: RCA

RCA for country i and product category j in year y on a 6-digit level is calculated according to Balassa (1965):

$$RCA_{i,j,y} = \frac{E_{i,j,y}/E_{i,t,y}}{E_{n,j,y}/E_{n,t,y}},$$

where $E_{i,j,y}$ is intraregional exports of country i in commodity j in year y, $E_{i,t,y}$ is total intraregional exports of country i in year j, $E_{n,j,y}$ is total intraregional exports of all regional countries in commodity j in year y and $E_{n,t,y}$ is total intraregional exports in

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year y.

Table 3.6: RCA - Estimation results

	(1) Bangladesh	(2) Bhutan	(3) India	(4) Maldives	(5) Nepal	(6) Pakistan	(7) Sri Lanka
RCA	-0.03**	0.00	-0.51**	0.00	0.06**	-0.02	0.09**
	(0.01)	(0.01)	(0.05)	(0.00)	(0.01)	(0.01)	(0.01)
R-square	0.00	0.00	0.02	0.00	0.01	0.00	0.05
N	1480	333	4826	1167	2014	2858	3457

* Significant at 5% level, ** Significant at 1% level.
Robust standard errors.

Appendix D: Trade Creation by Industry

Table 3.7: Trade Creation by Industry - Estimation Results

	(1) K	(2) A+B	(3) F	(4) E	(5) O
Share IR trade	18%	15%	13%	12%	11%
Safta*PosList	0.98**	0.88*	0.79**	0.40	-.04
	(0.30)	(0.43)	(0.30)	(0.67)	(0.27)
Safta	-4.82*	-1.21	-1.85	0 .90	-3.18
	(2.34)	(1.70)	(2.35)	(0.75)	(1.77)
PosList	0.2	-2.36**	-1.21**	-0.77*	-0.75**
	(0.14)	(0.22)	(0.18)	(0.36)	0.18
Time FE	YES	YES	YES	YES	YES
Industry-Partner FE	YES	YES	YES	YES	YES
Trading pair FE	YES	YES	YES	YES	YES
R-square	0.14	0.27	0.17	0.2	0.19
N	48,996	18,862	32,653	5,436	28,861

* Significant at 5% level, ** Significant at 1% level.
Robust standard errors.

Stölting, Sarah (2010), Three Essays on International Trade
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