International Trade and Economic Development

by Ralph Ossa

A thesis submitted in May 2007 in fulfilment of the requirements for the degree of Doctor of Philosophy in Economics at the London School of Economics and Political Science

Declaration

I certify that this thesis presented by me in May 2007 for examination for the PhD degree of the University of London is solely my own work.

Signature R. Osa ....

Date 25/05/07 ....

Abstract

In this thesis, I theoretically investigate three related aspects of international trade and economic development.

First, I present a model of social learning about the suitability of local conditions for new business ventures and explore its implications for the microeconomic patterns of economic development. I show that: i) firms tend to 'rush' into business ventures with which other firms have had surprising success thus causing development to be 'lumpy'; ii) sufficient business confidence is crucial for fostering economic growth; iii) development may involve wave-like patterns of growth where successive business ventures are first pursued and then given up; iv) there is, nevertheless, no guarantee that firms pursue the best venture even in the long-run.

Second, I offer a new explanation for the empirical finding that trade liberalization increases firm productivity. In particular, I develop a simple general equilibrium model of trade in which trade liberalization leads to outsourcing as firms focus on their core competencies in response to tougher competition. Since firms are better at performing tasks the closer they are to their core competencies, this outsourcing increases firm productivity.

Third, I propose a novel theory of GATT/WTO negotiations which solves two important problems of the standard terms-of-trade theory. First, it is consistent with the fact that GATT/WTO regulations do not constrain export taxes. Second, it does not rely on the terms-of-trade argument but instead emphasizes market access considerations. To achieve this, I consider trade policy in a 'new trade' environment. I first argue that tariffs are inefficiently

high in the non-cooperative equilibrium because countries attempt to improve their relative market access at the expense of other countries. I then show how GATT/WTO negotiations can help countries overcome this inefficiency by providing new rationales for the GATT/WTO principles of reciprocity and nondiscrimination.

Contents

List of Figures

Acknowledgements

I am especially indebted to my thesis advisor Stephen Redding for providing outstanding guidance and support throughout my PhD. Special thanks also go to Pol Antras for making my spring 2006 visit to Harvard University an invaluable academic experience. Their commitment to teaching and advising is truly exceptional and will be my benchmark when I start teaching and advising myself.

I would also like to thank Holger Breinlich, Alejandro Cunat, Frederic Robert-Nicoud, Keith Head, Elhanan Helpman, Gianmarco Ottaviano, Henry Overman, Dani Rodrik, and Tony Venables for very helpful comments and suggestions.

Financial support of the Economic and Social Research Council, the London School of Economics and Political Science, and the Royal Economic Society is gratefully acknowledged.

1 Introduction

In this thesis, I theoretically investigate three related aspects of international trade and economic development.

First, I develop a new model of technology adoption in which firms learn about the suitability of local conditions for new business ventures from observing other firms. This model delivers four main results. First, I show that firms tend to 'rush' into business ventures with which other firms have had surprising success thus causing development to be 'lumpy'. One implication of this 'lumpiness' is that improvements in the economic environment (policies, institutions, infrastructure, etc.) which trigger entry into unexplored business ventures can potentially kick-start economic development. Second, I demonstrate that sufficient business confidence is crucial for fostering economic growth. If firms have overly pessimistic initial beliefs, viable business ventures remain unattempted, whereas overly optimistic beliefs never make firms pursue non-viable ventures permanently. However, even if initial beliefs are sufficiently optimistic, viable ventures may be abandoned if firms misinterpret the evidence available to them. Third, I establish that development may involve a wave-like pattern of growth where successive business ventures are first pursued and then given up until a venture is found for which local conditions are sufficiently suitable. Finally, I show that, despite this potential 'stuttering' towards a viable venture, there is no guarantee that firms pursue the best venture even in the long-run. This model is introduced and developed in detail in the second chapter.

Second, I offer a new explanation for the empirical finding that trade liberalization increases firm productivity. In the context of a simple general equilibrium model of trade, I show that trade liberalization leads to outsourcing as firms focus on their core competencies in response to tougher competition. Since firms are better at performing tasks the closer they are to their core competencies, this outsourcing then increases firm productivity. Besides establishing this result, I also investigate the links between various technological parameters and outsourcing. In particular, I analyse how technological progress, changes in fixed costs, and changes in internal governance costs affect firms' integration decisions. This model is introduced and developed in detail in the third chapter.

Third, I propose a new theory of GATT/WTO negotiations which solves two important problems of the standard terms-of-trade theory. First, it is consistent with the fact that GATT/WTO regulations do not constrain export taxes. Second, it does not rely on the terms-of-trade argument but instead emphasizes market access considerations. To achieve this, I consider trade policy in a monopolistically competitive environment. I first argue that tariffs are inefficiently high in the non-cooperative equilibrium because countries attempt to improve their relative market access at the expense of other countries. I then show how GATT/WTO negotiations can help countries overcome this inefficiency by providing new rationales for the fundamental GATT/WTO principles of reciprocity and nondiscrimination. This model is introduced and developed in detail in the fourth chapter.

2 A Gold Rush Theory of Economic Development

2.1 Introduction

Technology transfers are a prerequisite for many new business ventures in developing countries. This tends to make the prospects of such ventures hard to predict, as it is often unclear how suitable local conditions are for the transferred technology.[1] The experiences of pioneering firms play an important role in reducing this uncertainty. Their success with new business ventures is indicative of the suitability of local conditions, thus revealing information useful in guiding other firms' investment decisions.[2]

Under these conditions, firms not only learn from their own experience but also from the experiences of other firms so that knowledge about the suitability of local conditions for new business ventures is acquired through a process of social learning. In this chapter, I develop a model of such social learning and explore its implications for the microeconomic patterns of growth. In this model, firms update their prior beliefs about the suitability of local conditions for particular business ventures in a Bayesian fashion by observing their own experience and the experiences of other firms with these ventures. Four main results emerge from the analysis. First, I show that firms tend to 'rush' into business ventures with which other firms have had surprising success thus causing development to be 'lumpy'. One implication

[1] Rosenberg (1982, p. 249), for example, writes that "the successful transfer of technology is not a matter of transporting a piece of hardware from one geographic location to another (but) depends greatly upon the specific domestic circumstances in the recipient country". Evenson and Westphal (1995, pp. 2262–2263) emphasize that "the body of case study research and anecdotal evidence includes numerous cases of failure to achieve the minimum mastery needed to attain the levels of productivity expected when the physical investment was undertaken. It also includes numerous cases of unforeseen success in achieving sufficient mastery to exceed the expected levels of productivity".

[2] Evenson and Westphal (1995), for example, cite several cases of such a technology diffusion from pioneering firms to imitators.

of this 'lumpiness' is that improvements in the economic environment (policies, institutions, infrastructure, etc.) which trigger entry into unexplored business ventures can potentially kick-start economic development. Second, I demonstrate that sufficient business confidence is crucial for fostering economic growth and development. If firms have overly pessimistic initial beliefs, viable business ventures remain unattempted, whereas overly optimistic beliefs never make firms pursue non-viable ventures permanently. However, even if initial beliefs are sufficiently optimistic, viable ventures may be abandoned if firms misinterpret the evidence available to them. Third, I establish that development may involve a wave-like pattern of growth where successive business ventures are first pursued and then given up until a venture is found for which local conditions are sufficiently suitable. Finally, I show that, despite this potential 'stuttering' towards a viable venture, there is no guarantee that firms pursue the best venture even in the long-run.

Case study evidence suggests that this 'lumpiness' and the associated 'stuttering' towards a viable business venture seem to be important characteristics of the microeconomic pattern of growth and that the above mentioned social learning plays an important role in bringing about such 'lumpiness' and 'stuttering'. Regarding 'lumpiness', Rhee (1990), for example, reports that Bangladesh's garment industry experienced a sudden and rapid takeoff in the late 1980s due to the wide imitation of a surprisingly successful initial business venture of the Daewoo Corporation of Korea.[3] In a related paper, Rhee and Belot (1990) point out that the astonishing success of the Colombian

[3]Interestingly, Rhee (1990) points out that Daewoo did not have much confidence in the project reflecting the uncertain success of technology transfers. It mainly viewed the venture as a vehicle to get involved in some of Bangladesh's other industries.

cut flower industry originated in a single surprisingly successful investment of an American entrepreneur which was then imitated by local entrepreneurs. Burgess and Venables (2004) present further evidence that development is often 'lumpy' and conclude that 'lumpiness' is an important characteristic of the microeconomic pattern of growth. As for the 'stuttering' towards a viable business venture, an interesting example is provided by Urquiola et al. (1999) who report that the recent growth of the agricultural sector in lowland Bolivia was driven by successive booms of rice, cotton, sugar cane, and finally soybeans.[4] As is pointed out by Arrieta et al. (1990, pp. 221-258), the unfavourable local conditions (in particular climate and soil) were among the main reasons why the booms of rice, cotton, and sugar cane all came to an end eventually.

To the best of my knowledge, this chapter is the first attempt to explore the implications of social learning about the suitability of local conditions for new business ventures on the microeconomic patterns of economic development. Hoff (1997) and Hausmann and Rodrik (2003) also study social learning about the suitability of local conditions for new business ventures, but focus on the inefficiency which comes along with the learning externality, rather than studying its implications for the microeconomic patterns of growth. Entrepreneurship is shown to be underprovided in these papers due to the divergence between the private and the social value of gaining experience. Burgess and Venables (2004) sketch a framework which suggests that increasing returns to scale which are external to individual firms (e.g. thick market externalities)

[4] In particular, it is reported that the share of rice, cotton, sugarcane, and soybeans in the total area under cultivation exceeded 20 percent in successive time periods. The shares of rice, cotton, and sugarcane declined quickly after their respective booms. Soybean cultivation, on the contrary, remained successful and is now dominating the local agriculture.

could be underlying 'lumpy' development. Social learning about the suitability of local conditions for new business ventures does not play a role in their analysis. This social learning, however, seems crucial for understanding the above examples of 'lumpy' development as well as the observed 'stuttering' towards a viable business venture.[5]

The remainder of this chapter is organized as follows. The next section lays out the basic model and establishes the first two results of the chapter. A third section then generalizes this basic model and derives both remaining results. A fourth section concludes.

2.2 The basic model

2.2.1 The setup

Consider an economy with two sectors - traditional and modern - which is inhabited by L workers and is endowed with T units of land. The traditional sector uses both land and labour while the modern sector requires labour only. Initially, all workers are employed in the traditional sector so that the modern sector is not operating. It is uncertain how suitable local conditions are for modern sector production and modern sector firms rely on their exogenous initial beliefs when deciding on whether or not to invest in the modern sector. If their priors are optimistic enough so that there is entry into the modern sector, some information about the unknown parameter is revealed. In particular, the

[5] Caplin and Leahy (1993) also explore the welfare implications of such social learning in the context of structural change and again demonstrate that entrepreneurship is underprovided. In a related paper, Caplin and Leahy (1998) show that social learning can potentially explain the rapid revitalization of New York's Lower Sixth Avenue. Hausmann, Hwang, and Rodrik (2005) argue that a country's pattern of specialization is in part determined through social learning and provide some evidence that the pattern of specialization is a determinant of economic growth.

outputs of the active modern sector firms are indicative of the suitability of local conditions for modern sector production, and this information is then used by firms to update their prior beliefs in a Bayesian fashion. Importantly, all firms are assumed to observe these outputs (not only the active modern sector firms). Moreover, their priors are assumed to be identical so that the best guess about the unknown parameter is always the same among all firms. Also, potential costs of entering or leaving the modern sector are ignored. Therefore, there is no intertemporal trade-off to be solved by the firms when making their entry decision. Free entry ensures that, in all time periods, the number of modern sector firms is such that expected profits are driven down to zero. The equilibrating mechanism is labour market competition. Workers have to be attracted from the traditional sector which increases the wage rate. Output prices do not play a role here. The economy is supposed to be small relative to other economies and trades both modern and traditional sector goods at fixed prices.[6] For simplicity, a demand side is not explicitly modelled. In a small open economy, production decisions are independent of consumption decisions, and a particular demand structure only has to be imposed if one wants to solve for domestic consumption or the pattern of international trade.

2.2.2 The modern sector

Technology It is assumed that each modern sector firm has a fixed labour requirement l. Modern sector firm output is determined by multiplying this fixed labour requirement by the productivity parameter ϕ, a random variable

[6] Another option would be to use product market competition as the equilibrating mechanism. This modification would be relatively straightforward and the results of the basic model would remain unchanged.

which can take two values, $\overline{\phi}$ (high productivity) and $\underline{\phi}$ (low productivity), $\overline{\phi} > \underline{\phi} > 0$. The suitability of local conditions for modern sector production is captured by p, the probability that productivity is high. This parameter is fixed but unknown to the firms. Denoting modern sector firm output by y, modern sector technology is thus given by

$$y_{it} = \phi_{it} l \tag{1}$$

where $\phi_{it} = \overline{\phi}$ with probability p, $\phi_{it} = \underline{\phi}$ with probability $1-p$ and i indexes firms and t indexes time. In short, firms can either be successful or not and the suitability of local conditions determines average firm success.[7]

All the risk is assumed to be borne by the modern sector firms in this model. At the beginning of the period modern sector firms enter (exit) the modern sector and hire (lay off) workers which determines the wage rate. Then the productivities are drawn, determining whether a firm makes profits or losses.[8]

Learning Firms have exogenously given prior beliefs about p which they update through a process of Bayesian learning. It is assumed that all firms can observe the outputs of all modern sector firms so that the history of modern sector firm output is common knowledge. Since a modern sector firm's output is either high or low according to whether the productivity draw of the given firm in the given time period was good or bad, the number of good productivity draws in all draws is also common knowledge. Since all modern sector firms

[7]Notice that this specification of technology guarantees that y can only take positive values.

[8]Of course, one has to assume that modern sector firms own some assets which they can use to finance the losses in the bad state. This will be done henceforth.

have access to the same information and use the same updating method, beliefs are the same among firms in all time periods.

Priors In particular, suppose that the firms' beliefs about p are characterized by a beta distribution, $p \sim Be(\alpha, \beta)$, so that[9]

$$f(p) \propto p^{\alpha-1}(1-p)^{\beta-1} \tag{2}$$

The beta distribution is a relatively general distribution on the support $[0,1]$. Basically, all reasonably smooth unimodal distributions on this support can be approximated by a beta distribution by choosing suitable values for the parameters α and β. This includes the case of uniform priors ($\alpha = \beta = 1$) which is probably the most intuitive starting point in the case of complete ignorance.[10] For future reference, recall that if $p \sim Be(\alpha, \beta)$, then $E(p) = \frac{\alpha}{\alpha+\beta}$.

Updating Consider now the updating of these beliefs. Denote the number of good draws until period $t-1$ by z_{t-1} and the total number of draws by n_{t-1}. If m_t is the number of modern sector firms operating in period t and s_t is the number of high productivity draws in period t, then $z_{t-1} = s_1 + ... + s_{t-1}$ and $n_{t-1} = m_1 + ... + m_{t-1}$. As discussed above, these two variables can be inferred from the output history and constitute the information set available to firms at the beginning of period t. By Bayes' Rule, the posterior beliefs are

[9] Recall that the beta distribution has density $f(p) = \frac{1}{B(\alpha,\beta)} p^{\alpha-1}(1-p)^{\beta-1}$, where $0 \leq p \leq 1$, $B(\alpha,\beta) = \frac{(\alpha-1)(\beta-1)}{\alpha+\beta-1}$.

[10] The proposition that uniform priors should be used in the case of complete ignorance is sometimes referred to as Bayes' postulate.

given by

$$f(p \mid z_{t-1}, n_{t-1}) = \frac{g(z_{t-1} \mid p, n_{t-1}) f(p)}{g(z_{t-1})} \tag{3}$$

where $g(.)$ is a density function which is further defined below. Since z_{t-1} is just the number of 'successes' in a series of n_{t-1} draws, z_{t-1} follows a binomial distribution of index n_{t-1} and parameter p, $z_{t-1} \sim B(n_{t-1}, p)$ so that

$$g(z_{t-1} \mid p, n_{t-1}) = \begin{bmatrix} n_{t-1} \\ z_{t-1} \end{bmatrix} p^{z_{t-1}} (1-p)^{n_{t-1}-z_{t-1}} \tag{4}$$

Recalling that $f(p) \propto p^{\alpha-1}(1-p)^{\beta-1}$ it then follows that

$$f(p \mid z_{t-1}, n_{t-1}) \propto p^{\alpha+z_{t-1}-1}(1-p)^{\beta+n_{t-1}-z_{t-1}-1} \tag{5}$$

and hence

$$p \mid z_{t-1}, n_{t-1} \sim Be(\alpha + z_{t-1}, \beta + n_{t-1} - z_{t-1}) \tag{6}$$

These are the updated beliefs at the beginning of period t. They are again beta distributed so that the incoming information only changes the parameters of the underlying distribution of beliefs but not the distribution itself.[11] This implies in particular that

$$E(p \mid z_{t-1}, n_{t-1}) = \frac{\alpha + z_{t-1}}{\alpha + \beta + n_{t-1}} \tag{7}$$

Discussion Modern sector firms are assumed to be risk-neutral so that the expected probability of a high modern sector firm productivity will be

[11] In other words, the beta distribution is thus conjugate to a binomial likelihood which makes it a suitable prior distribution for the purposes of this model. See Lee (1998) for more details on this derivation.

a key variable in the analysis. Before proceeding with the remainder of the model, it is therefore useful to clarify some of the properties of the updating of this expectation. For this purpose, the following decomposition is particularly insightful. It is easy to show that the posterior expectation is just a weighted average of the prior expectation and the 'success rate', the ratio of high productivity draws to total draws,

$$E(p \mid z_{t-1}, n_{t-1}) = \lambda_{t-1}E(p) + (1 - \lambda_{t-1})\frac{z_{t-1}}{n_{t-1}} \tag{8}$$

where $\lambda_{t-1} = \frac{\alpha+\beta}{\alpha+\beta+n_{t-1}}$. Notice that λ is decreasing in the total number of draws which is very intuitive. The success rate $\frac{z_{t-1}}{n_{t-1}}$ is a natural estimator of p and it becomes the more influential relative to the prior belief, the more experience has been gained in the modern sector. Several things become obvious from this decomposition. First, it becomes clear that only surprises change the firms' beliefs since $E(p \mid z_{t-1}, n_{t-1}) \lesseqgtr E(p) \iff \frac{z_{t-1}}{n_{t-1}} \lesseqgtr E(p)$ $\iff \frac{z_{t-1}}{n_{t-1}} \lesseqgtr E(\frac{z_{t-1}}{n_{t-1}})$.[12] Second, it is revealed that beliefs converge to the truth as the number of observations increases since $\lim_{n_{t-1} \longrightarrow \infty} \lambda_{t-1} = 0$ and $\frac{z_{t-1}}{n_{t-1}}$ converges to p as $n_{t-1} \longrightarrow \infty$. Third, it follows that the current beliefs can always be calculated by updating the initial beliefs using formula (8). The result is the same as if the current beliefs are calculated recursively by applying the updating rule period by period. To see this define $p_t \equiv E(p \mid z_{t-1}, n_{t-1})$ and consider the sequence $p_1, ..., p_t, ..., p_T$. From the above formulae it follows that $p_T = \frac{\alpha+\beta}{\alpha+\beta+(m_1+...+m_{T-1})}p_1 + \frac{(m_1+...+m_{T-1})}{\alpha+\beta+(m_1+...+m_{T-1})}\frac{(s_1+...+s_{T-1})}{(m_1+...+m_{T-1})}$ if the initial be-

[12] It is also easy to show that $E(p \mid z_{t-1}, n_{t-1}) = \widetilde{\lambda}_{t-1}E(p \mid z_{t-2}, n_{t-2}) + \left(1 - \widetilde{\lambda}_{t-1}\right)\frac{s_{t-1}}{m_{t-1}}$, where $\widetilde{\lambda}_{t-1} = \frac{\alpha+\beta+n_{t-2}}{\alpha+\beta+n_{t-1}}$, which emphasizes this point. Relative to the *previous* rather than the *initial* period, $\frac{s_{t-1}}{m_{t-1}} \lesseqgtr E(p \mid z_{t-2}, n_{t-2})$ is a surprise.

lief is used and $p_T = \frac{\alpha'+\beta'}{\alpha'+\beta'+(m_t+...+m_{T-1})}p_t + \frac{(m_t+...+m_{T-1})}{\alpha+\beta+(m_t+...+m_{T-1})}\frac{(s_t+...+s_{T-1})}{(m_t+...+m_{T-1})}$ if the period t belief is used, where $\alpha' = \alpha + (s_1 + ... + s_{t-1})$ and $\beta' = \beta + (m_1 + ... + m_{t-1}) - (s_1 + ... + s_{t-1})$. Some manipulation reveals that both expressions are indeed the same.[13]

2.2.3 Traditional sector

The traditional sector is assumed to be perfectly competitive with constant returns to scale technology. Apart from labour, it also requires land for production (e.g. the agricultural sector). In particular, technology is of the Cobb-Douglas type:

$$x_t = \left(T_t^T\right)^\gamma \left(L_t^T\right)^{1-\gamma} \tag{9}$$

where x is traditional sector output, T^T is the land employed in the traditional sector, L^T is the labour employed in the traditional sector, and $0 < \gamma < 1$. Equation (9) gives the aggregate traditional sector output. Firm subscripts have been omitted as individual firm size is anyway indeterminate with constant returns to scale technology. Choose units such that the price of the traditional sector good is 1 so that the value marginal product of labour in the traditional sector is given by $(1-\gamma)\left(\frac{T_t}{L_t^T}\right)^\gamma$. As usual, workers are paid their value marginal product so that the (inverse) labour supply curve faced by modern sector firms trying to attract workers from the traditional sector is given by

$$w_t = (1-\gamma)\left(\frac{T}{L - L_t^M}\right)^\gamma \tag{10}$$

[13] All these are general properties of Bayesian learning. See, for example, Chamley (2004) for more on this issue.

In this equation, w is the wage rate and the factor market clearing conditions $L = L_t^T + L_t^M$ and $T_t^T = T$ have been imposed. Recalling that modern sector firms have a fixed labour requirement l so that the number of modern sector firms at time t is given by $m_t = \frac{L_t^M}{l}$, the wage rate is given by

$$w_t = (1 - \gamma) \left(\frac{T}{L - lm_t} \right)^{\gamma} \tag{11}$$

The wage rate hence increases in all time periods in which firms are entering the modern sector. This is, of course, due to fact that the Cobb-Douglas technology exhibits diminishing returns to labour.

2.2.4 Equilibrium

If units are again chosen such that the price of the modern sector good is 1,[14] modern sector firm profits in period t are given by

$$\pi_{it} = \phi_{it} l - w_t l \tag{12}$$

From above, recall the notation $p_t \equiv E(p \mid z_{t-1}, n_{t-1})$. At the beginning of period t, period t profits are thus expected to be

$$E(\pi_{it} \mid z_{t-1}, n_{t-1}) = \left[p_t \overline{\phi} + (1 - p_t) \underline{\phi} - w_t \right] l \tag{13}$$

As discussed previously, free entry drives $E(\pi_{it} \mid z_{t-1}, n_{t-1})$ down to zero. Firms are not willing to invest in period t unless they expect to make profits

[14] Recall that the economy is assumed to be small relative to other economies and trades both modern and traditional sector goods at fixed prices. Therefore, it is possible to choose units in both sectors which set goods prices equal to 1.

in period t. They never invest just to learn something about the suitability of local conditions since the private value of this information is zero. If there is a good surprise and local conditions turn out to be very favourable for modern sector production, this becomes common knowledge and triggers entry in the following period. Using the wage rate from equation (11), the equilibrium number of modern sector firms at time t can thus be computed from setting (13) equal to zero,

$$m_t = \kappa - \frac{\rho}{\left[p_t\overline{\phi} + (1-p_t)\underline{\phi}\right]^{\frac{1}{\gamma}}} \tag{14}$$

where the parameters $\kappa \equiv \frac{L}{l}$ and $\rho \equiv \frac{T}{l}(1-\gamma)^{\frac{1}{\gamma}}$ have been introduced to simplify the notation.[15] Since $\overline{\phi} > \underline{\phi}$, the equilibrium number of firms is thus increasing in p_t. The better local conditions are believed to be, the more modern sector firms are operating. Together with equation (7), this equation yields

$$\begin{aligned} m_t &= \kappa - \frac{\rho}{\left[\frac{\alpha+z_{t-1}}{\alpha+\beta+n_{t-1}}\left(\overline{\phi}-\underline{\phi}\right)+\underline{\phi}\right]^{\frac{1}{\gamma}}} \\ &= \kappa - \frac{\rho}{\left[\frac{\alpha+(s_1+\ldots+s_{t-1})}{\alpha+\beta+(m_1+\ldots+m_{t-1})}\left(\overline{\phi}-\underline{\phi}\right)+\underline{\phi}\right]^{\frac{1}{\gamma}}} \end{aligned} \tag{15}$$

Hence, the number of firms in period t depends on the number of firms in previous periods and the history of productivity draws. The industrialization path is random, since changes in beliefs are driven by the random productivity draws. Notice also that, for a given history, the number of firms is increasing in α and decreasing in β. This is because an increase in α (β) makes beliefs

[15] Of course, the equilibrium number of modern sector firms cannot be negative. So if $\kappa \leq \frac{\rho}{\left[p_t\overline{\phi}+(1-p_t)\underline{\phi}\right]^{\frac{1}{\gamma}}}$, $m_t = 0$.

more skewed to the left (to the right) so that local conditions are believed to be more (less) suitable for modern sector production.

To make the model interesting, assume that

$$\underline{\phi} < \left(\frac{\rho}{\kappa}\right)^{\gamma} < \overline{\phi} \tag{16}$$

This assumption ensures that the modern sector firms' entry decisions are not independent of their beliefs. If $\left(\frac{\rho}{\kappa}\right)^{\gamma} < \underline{\phi}$, the initial wage rate would be so low that it would be profitable to enter the modern sector even if the bad state occurred with certainty. Similarly, if $\overline{\phi} < \left(\frac{\rho}{\kappa}\right)^{\gamma}$, the initial wage rate would be so high that it would not be profitable to enter the modern sector even if the good state occurred with certainty. With this condition, there hence exists an expected success probability $\overline{p}$ such that the modern sector is operating if and only if beliefs are more optimistic than $\overline{p}$. From equation (14) it follows that this threshold belief is given by[16]

$$\overline{p} = \frac{\left(\frac{\rho}{\kappa}\right)^{\gamma} - \underline{\phi}}{\overline{\phi} - \underline{\phi}} \tag{17}$$

It is easy to show that $\overline{p}$ is decreasing in both productivities given that the above parameter restriction is satisfied. This is not surprising since higher productivities make modern sector production more attractive regardless of the suitability of local conditions.

This completes the derivation of the basic model. The next section now turns to analysing its implications for industrial growth and development.

[16]Notice that $\underline{\phi} < \left(\frac{\rho}{\kappa}\right)^{\gamma} < \overline{\phi} \iff 0 < \overline{p} < 1$.

2.2.5 Analysis

This analysis of the basic model establishes the first two results of the chapter. In a first part, it is shown that sufficient business confidence is crucial for fostering economic growth. The discussion in that part also serves to characterize more generally the development patterns which are consistent with the model. In a second part, it is then demonstrated how social learning about the suitability of local conditions for new business ventures can lead to 'lumpy' economic development.

Business confidence and the patterns of modern sector development

In this model, business confidence is captured by the firms' initial beliefs about the suitability of local conditions for modern sector production. Three main points need to be made to characterize how these beliefs shape the microeconomic patterns of growth:

1. If initial beliefs are sufficiently pessimistic, there will never be any modern sector production regardless of how suitable local conditions are in reality. If $p_1 < \overline{p}$, no firm finds it profitable to invest in the modern sector in the first time period. But without modern sector activity, there is no learning and hence no investment in future time periods. No firm has an incentive to incur an expected loss in one period in order to learn something about the suitability of local conditions for modern sector production, since this information has no private value in the given context of social learning.

2. If local conditions are not suitable for modern sector production, $p < \overline{p}$, modern sector production will always be given up at some point in time.

If local conditions are suitable for modern sector production, $p > \overline{p}$, and modern sector production is not given up, the number of firms will converge to the full information equilibrium

$$m^{FI} = \kappa - \frac{\rho}{\left[p\overline{\phi} + (1-p)\underline{\phi}\right]^{\frac{1}{\gamma}}} \tag{18}$$

This is due to the convergence property of Bayesian learning which was discussed in section (2.2.2). If the modern sector does not stop operating, $n_{t-1} \longrightarrow \infty$ as $t \longrightarrow \infty$ so that $p_t \longrightarrow p$. Beliefs converge to the truth as experience is gained in the modern sector. If $p < \overline{p}$ and $p_1 > \overline{p}$ so that there is some modern sector activity initially although local conditions are not suitable for modern sector production, beliefs will therefore hit $\overline{p}$ at some point in time with probability 1. From then on, the modern sector will stop operating and beliefs will remain unchanged since no new information becomes available. Similarly, if $p > \overline{p}$ and $p_1 > \overline{p}$ so that there is some modern sector activity initially and local conditions are suitable for modern sector production, beliefs will converge to the truth provided that modern sector production is not given up. As $p_t \longrightarrow p$, $m_t \longrightarrow m^{FI}$ from equation (14).

3. Even if there is some modern sector activity initially and local conditions are suitable for modern sector production, $p > \overline{p}$ and $p_1 > \overline{p}$, modern sector production will be given up with a positive probability. This is because p is only the expected value of the success rate $\frac{s_t}{m_t}$ which is distributed over $[0, 1]$. Sufficient bad luck will lead to a series of bad surprises $\frac{s_t}{m_t} < p_t$ which will drag down beliefs to the threshold level $\overline{p}$.

The more suitable local conditions are for modern sector production (the higher p) and the more optimistic initial beliefs are (the higher p_1), the less likely it is that a viable modern sector is given up. The higher p, the less likely it is to get a sufficient number of success rates $\frac{s_t}{m_t} < \overline{p}$ which are necessary to make beliefs reach $\overline{p}$ if $p_1 > \overline{p}$ as is obvious from the updating formula. Also, the higher p_1, the more success rates $\frac{s_t}{m_t} < \overline{p}$ are required to make beliefs reach $\overline{p}$ if $p_1 > \overline{p}$ as the incoming information is always weighted with p_1.

As an illustration, the case of a viable modern sector and too pessimistic initial beliefs is drawn in figure (1). The two dotted lines illustrate that if the priors are such that there will be some initial activity in the modern sector, beliefs either converge to the truth or to the threshold level. This corresponds to the number of firms converging to the full information equilibrium or to modern sector production being given up. The dashed line illustrates that if priors are such that there is no initial investment, then beliefs will stay unchanged since no experience is gained.

In summary, if firms have overly pessimistic initial beliefs, viable business ventures remain unattempted, whereas overly optimistic beliefs never make firms pursue non-viable ventures permanently. However, even if initial beliefs are sufficiently optimistic, viable ventures may be abandoned if firms misinterpret the evidence available to them.

'Lumpiness' of modern sector development In their analysis of 'lumpy' economic development, Burgess and Venables (2004) suggest to divide the determinants of microeconomic growth into '1st advantages' and '2nd advan-

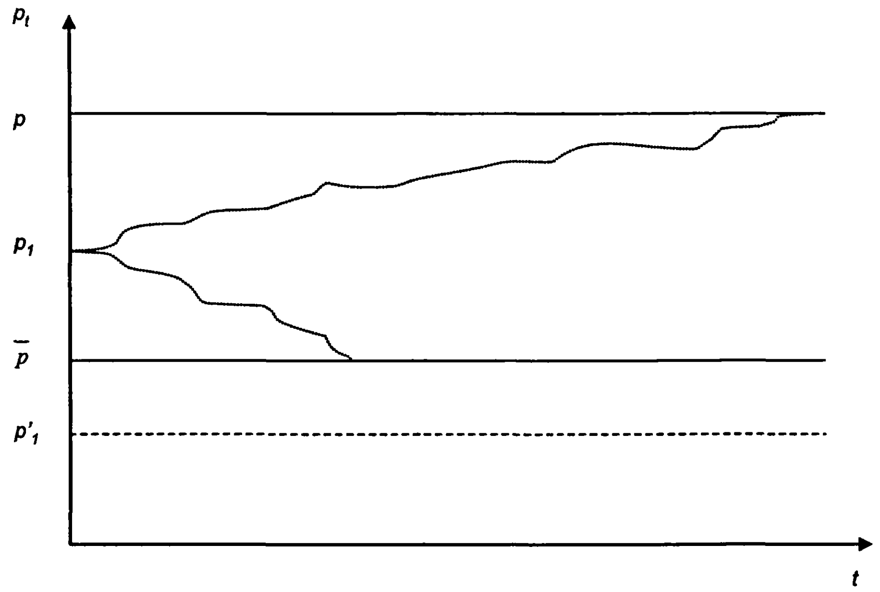

Figure 1: Business confidence and the microeconomic patterns of growth

tages'. In their framework, '1st advantages' capture the prerequisites of growth such as good policies, institutions, and infrastructure, while '2nd advantages' cover the self-reinforcing aspects of growth which boost modern sector development once it has started. As indicated earlier, increasing returns to scale which are external to the firm (e.g. thick market externalities) are thought to be underlying these '2nd advantages' in their analysis.

Although thick markets do not play a role here, it is nevertheless insightful to apply this conceptual framework to the present analysis. Here, '1st advantages' are captured by the two productivity parameters which get larger as the economic environment improves. Once the environment is favourable enough to induce some modern sector investment, the evolution of beliefs becomes important for the pattern of development. Due to the learning dynamics, this development pattern can - though need not - be self-reinforcing so that social learning can be seen as a potential source of '2nd advantage'. To see this, consider an initial situation where beliefs are such that no firm has an incentive to invest in the modern sector. As '1st advantages' improve, $\overline{\phi}$ and $\underline{\phi}$ increase so that $\overline{p}$ decreases. If the productivities increase sufficiently, $\overline{p}$ will at some point become lower than p_1 so that some firms enter the modern sector. Now the process of learning begins. Since beliefs only become more optimistic as a consequence of good surprises, the modern sector will only continue to grow if the productivity draws are surprisingly good, $\frac{s_t}{m_t} > p_t$. This can happen either by chance or because local conditions are truly surprisingly suitable for modern sector production, $p > p_1$. If it happens by chance and local conditions are in reality not very well suited for modern sector production, modern sector development will take an inverted u-shape since eventually beliefs must converge to the truth. If, however, local conditions are indeed surprisingly favourable, learning can lead to longer lasting, rapid growth until the full information equilibrium is attained. It is this adjustment of expectations following overly pessimistic initial beliefs that can bring about 'lumpy' modern sector development in this model.

This is illustrated in figure (2). Suppose that at time t^* '1st advantages' are such that some investment in the modern sector occurs. If local conditions are in reality not suitable for modern sector production so that the full information equilibrium number of firms is zero, then good surprises can only occur by chance which can give rise to an inverted u-shaped development pattern as depicted by the dashed line. If, however, the full information equilibrium number of firms is positive, good surprises do not come by accident and can give rise to rapid modern sector development as shown by the dotted line. Then learning about the suitability of local conditions has a '2nd advantage' character since growth is then self-reinforcing.

Notice that this discussion also implies that improvements in the economic environment may map discontinuously into microeconomic growth. As long as increases in the productivity parameters are not sufficient to trigger entry into the modern sector, the improvement in the economic environment does not have any effects. But if the economic environment becomes sufficiently good so that some firms invest in the modern sector, the modern sector may take-off suddenly so that small changes in the institutional environment may trigger rapid economic development.

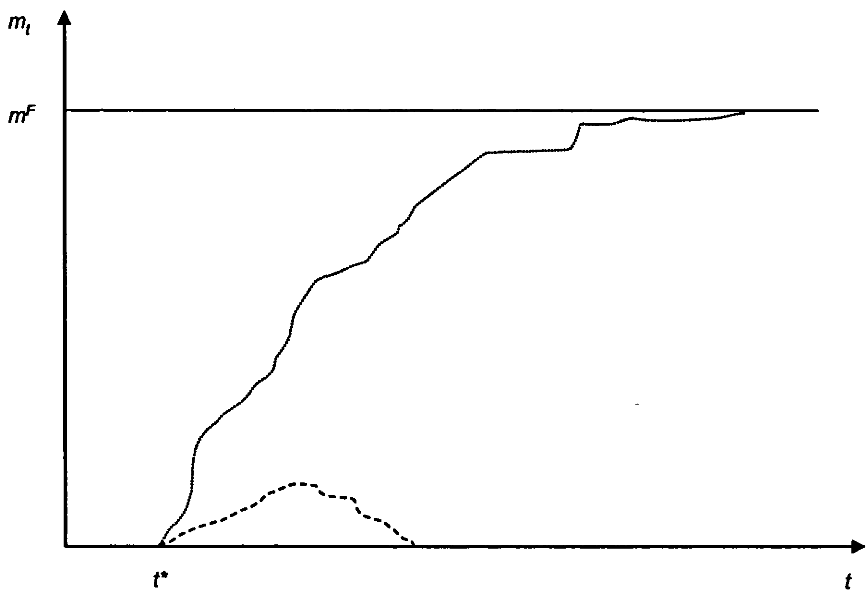

Figure 2: Sudden and rapid modern sector development

2.3 Multiple modern sectors or multiple regions

Consider now a simple extension of the basic model allowing for multiple sectors. This extension delivers the two main additional results. First, it is established that development may involve a wave-like pattern of growth where successive business ventures are first pursued and then given up until a venture is found for which local conditions are suitable. Second, it is shown that, despite this potential 'stuttering' towards a viable venture, there is no guarantee that firms pursue the best venture even in the long-run.

Suppose thus that there are r modern sectors indexed by j or k and assume that local conditions suit different modern sectors differently so that $p^j \neq p^k$, $j \neq k$, for all $j,\ k = 1, 2, ..., r$. Only a few changes to the basic model are required to allow for this generalization. Modern sector technologies are now given by

$$y_{it}^j = \phi_{it}^j l \tag{19}$$

where $\phi_{it}^j = \overline{\phi}$ with probability p^j, $\phi_{it}^j = \underline{\phi}$ with probability $1 - p^j$, and $\overline{\phi} > \underline{\phi}$. Crucially, the parameter p now has an index j to denote that local conditions suit different modern sectors differently. At the beginning of period t, period t modern sector firm profits in sector j are thus expected to be[17]

$$E(\pi_{it}^j \mid z_{t-1}^j, n_{t-1}^j) = \left[p_t^j \overline{\phi} + (1 - p_t^j)\underline{\phi} - w_t^j\right] l \tag{20}$$

Therefore, the maximum wage a firm of modern sector j can pay in period t and expect non-negative profits is given by

$$\overline{w_t^j} = p_t^j \overline{\phi} + (1 - p_t^j)\underline{\phi} \tag{21}$$

The discussion of this extended model is again summarized in three remarks. Remark 1 clarifies an important property of the extended model while remarks

[17]The output prices are again normalized to 1 for simplicity.

2 and 3 establish the main additional results:

1. At any given point in time, only one modern sector will operate. From equation (21) it is obvious that $\overline{w_t^j}$ is increasing in p_t^j. Since break even wages must be paid in equilibrium due to the free entry assumption, firms in the modern sector which is believed to perform best under the given local conditions are thus paying the highest wages. Firms of any other modern sector will not be able to afford these high wages and will not be operating. Notice that such extreme specialization even evolves if beliefs are uniform initially since one good surprise from one modern sector suffices to make firms 'rush' into that sector.

2. Although only one modern sector will operate at any given point in time, it need not always be the same one. As a given modern sector is active, information about the suitability of local conditions for this particular modern sector is revealed which changes the firms' beliefs about that sector. At the same time, beliefs about all other sectors are unaffected. A series of bad surprises, $\frac{s_t^k}{m_t^k} < p_t^k$ can drag down p_t^k to the level of the modern sector which was initially believed to be second best. Then this modern sector starts operating and information about it becomes available. If there are good surprises, it will continue to be active. If there are bad surprises, production in the initial modern sector will be resumed. Notice that a given sector k can only be operating in the long-run if $p^k > p_t^j$ for all $j \neq k$ since beliefs converge to the truth eventually. The *true* suitability of local conditions for a given modern sector must hence be better than the *expected* suitability of local conditions for all

other modern sectors.

The potential 'stuttering' towards a viable business venture follows as a corollary from this result. To see this most clearly, consider the extreme case where firms wrongly believe all sectors to be viable initially, $p_1^j > \overline{p}$ for all j, although local conditions are only suitable for modern sector k, $p^j < \overline{p}$ for all $j \neq k$ and $p^k > \overline{p}$. Then, of course, firms will eventually give up all sectors they attempt until they reach sector k, indeed giving rise to a wave-like pattern of economic development.[18]

3. Production will not necessarily move to the best modern sector as time passes by and knowledge accumulates. From remark 1 we know that the modern sector which is believed to be best will be operating, in general, not the modern sector which is best in reality. From remark 2 we know that a modern sector can only be active over a long period of time if the true suitability of local conditions for that sector is better than the expected suitability of local conditions for all other modern sectors. This implies that the suitability of local conditions for the best sector must hence be underestimated to allow for a less productive modern sector to be operating in the long run.

Of course, the remarks from the basic model also apply with suitable modifications: 1) if initial beliefs are sufficiently pessimistic, no modern sector will develop; 2) if production is not viable in any of the modern sectors, it will be given up with probability 1. If one modern sector keeps operating for a long time, the equilibrium number of firms in that sector will converge to the re-

[18] As was clarified by remark 3 of the previous section, the firms may, of course, also give up the viable sector k by mistake.

spective full information value; 3) even if local conditions are suitable for some sectors and one of these modern sectors is active, modern sector production will be given up with a positive probability.

Notice that the same extension could also be interpreted as being the case of multiple regions which offer different suitabilities for modern sector production and share a common labour market. The predictions would, of course, be analogous: 1) only one region is operating a modern sector at any given point in time; 2) nevertheless, different regions can operate a modern sector at different points in time; 3) the modern sector will not necessarily move to the best region as time passes by.

2.4 Conclusion

In this chapter, I presented a model of social learning about the suitability of local conditions for new business ventures and explored its implications for the microeconomic patterns of growth. The analysis delivered four main results. First, firms tend to invest in business ventures with which other firms have had surprising success, thus causing development to be 'lumpy'. One consequence of this 'lumpiness' is that improvements in the economic environment (policies, institutions, infrastructure, etc.) may map discontinuously into microeconomic growth. Second, sufficient business confidence is crucial for fostering economic growth and development. If firms have overly pessimistic initial beliefs, viable business ventures remain unattempted, whereas overly optimistic beliefs never make firms pursue non-viable ventures permanently. However, even if initial beliefs are sufficiently optimistic, viable ventures may be abandoned if firms misinterpret the evidence available to them. Third, development may involve a wave-like pattern of growth where successive business ventures are first pursued and then given up until a venture is found for which local conditions are sufficiently suitable. Finally, despite this potential 'stuttering' towards a viable venture, there is no guarantee that firms pursue the best venture even in the long-run.

Although the role of technology transfers was stressed in the motivation of this chapter, the mechanisms which were highlighted here are probably at work in many other settings. Firms can learn from the experiences of other firms whenever there is non-idiosyncratic uncertainty, i.e. uncertainty concerning factors which affect all firms alike. Such social learning can then lead to 'lumpy' and 'stuttering' economic growth unless those uncertain business ventures are patentable.

Regarding future research, more formal econometric work on the importance of such learning externalities now seems to be most urgently needed. I believe that this chapter can be a useful starting point for such research since it delivers some observable (and potentially testable) predictions for the microeconomic patterns of growth.[19] The main challenge, of course, is to disentangle social learning from other determinants of the microeconomic patterns of growth.

[19] Hausman and Rodrik (2003, pp. 613-614), for example, argue that it is hard to test the predictions of their model since "much of our story has to do with outcomes that are not observed: the failure to develop non-traditional activities because of inadequate incentives to invest in learning what one is good at producing".

3 Trade Liberalization, Outsourcing, and Firm Productivity

3.1 Introduction

Evaluating the gains from trade liberalization has always been a key concern of international economics. Recently, many empirical studies have focused on the productivity effects of trade liberalization (e.g. Pavcnik 2002, Topalova 2004, Trefler 2004).[20] Their results suggest that there are important trade-induced improvements in overall productivity, either through gains in average firm productivity ('firm productivity effect') or through the reallocation of market share from less to more productive firms ('reallocation effect').

While the recent theoretical literature has mainly concentrated on understanding the reallocation effect (e.g. Melitz 2003, Bernard et al. 2003, Melitz and Ottaviano 2005), my focus is on the firm productivity effect. In the context of a simple general equilibrium model of trade, I show that trade liberalization leads to outsourcing as firms focus on their core competencies in response to tougher competition. Since firms are better at performing tasks the closer they are to their core competencies, this outsourcing then increases firm productivity. Besides establishing this result, I also investigate the links between various technological parameters and outsourcing. In particular, I analyse how technological progress, changes in fixed costs, and changes in internal governance costs affect firms' integration decisions.

To the best of my knowledge, this chapter is the first attempt to theoretically link trade-induced gains in firm and industry productivity to a vertical

[20] See Tybout (2002) for a survey of the earlier literature.

focusing on core competencies. Other papers have mainly emphasized increasing returns to scale (e.g. Krugman 1979), learning by exporting (e.g. Clerides, Lach, and Tybout 1998), competition-induced innovation (e.g. Aghion et al. 2005), or a horizontal focusing on core competencies by multi-product firms (e.g. Eckel and Neary, 2005; Bernard, Redding, and Schott, 2006; Nocke and Yeaple, 2006) as potential sources of the firm productivity effect. Only McLaren (2000) also studies the productivity gains of trade-induced vertical disintegration. Both the source of the productivity gains as well as the link between trade-liberalization and outsourcing are very different in his model, however.

Apart from proposing a new mechanism which helps understanding trade-induced increases in firm productivity, this chapter is also interesting from a modelling perspective. In particular, I solve for the range of vertically related production tasks performed within the boundaries of each firm, thus allowing me to study continuous changes in the degree of vertical integration. Previous work has usually considered two discreet 'upstream' and 'downstream' production facilities, which could either merge into a fully integrated firm or stay entirely disintegrated (e.g. Grossman and Helpman 2002).

The remainder of the chapter is structured as follows. Section 3.2 sets up the model and introduces the concepts 'value chain' and 'core competencies'. Section 3.3 derives the outsourcing decisions of firms, while section 3.4 solves for the general equilibrium. Section 3.5 is concerned with the comparative statics, establishing the key results. A final section concludes.

3.2 The basic setup

The model is a generalization of Krugman's (1979) monopolistic competition model of trade, the key difference being that the production process of a given variety is now divided between vertically related firms. The basic setup of Krugman (1979) is chosen because it features a competition effect generating a reduction in mark-ups following trade liberalization. As will become clear, this reduction in mark-ups is necessary for trade liberalization to affect vertical integration in this model.

3.2.1 Demand

Consider thus an economy producing and consuming $i = 1, ..., n_y$ final goods, where n_y is endogenous. There are L consumers who are endowed with one unit of labour each. Consumers have 'love of variety'-preferences

$$U = \sum_{i=1}^{n_y} v(x_i), \quad v'(x_i) > 0, \quad v''(x_i) < 0 \tag{22}$$

where $v(x_i)$ is the utility derived from consuming x units of final good i. They maximize this utility subject to their budget constraint

$$\omega = \sum_{i=1}^{n_y} p_i x_i \tag{23}$$

where ω is the wage rate and p_i is the price paid for good i. As can be seen from the first order condition of the consumer's maximization problem, the resulting demand has elasticity

$$\varepsilon(x_i) \equiv -\frac{v'(x_i)}{x_i v''(x_i)} \tag{24}$$

To introduce a competition effect into the model, assume that $\varepsilon'(x_i) < 0$. As is easy to verify, this is equivalent to assuming that demand is less convex than in the constant elasticity case (e.g. linear). Assume also that $\varepsilon(\infty) > 1$ and $\varepsilon(0) > \frac{1+\gamma}{\gamma}$, γ a positive and constant cost parameter to be defined below. As will be discussed later, these parameter restrictions are necessary to guarantee the existence of a monopolistic competition equilibrium.

3.2.2 Value chain

Consider now the production process of the final goods. The production of each of these goods requires the sequential performance of a number of tasks. Early tasks are concerned with obtaining raw materials which are then refined successively in later production stages. The set of these tasks is represented by a line of length v which I call the value chain. To produce the final good, all tasks $z \in [0, v]$ have to be performed sequentially. If only tasks $z \in [0, w_1]$, $0 < w_1 < v$, are performed, a preliminary good w_1 is obtained. This preliminary good w_1 can then be transformed into a more downstream preliminary good w_2, $0 < w_1 < w_2 < v$, by performing the additional tasks $z \in [w_1, w_2]$ and so on. One unit of each task is required to produce one unit of the final good. Similarly, one unit of the relevant subset of tasks is required to produce one unit of a preliminary good. The value chains of all final goods are assumed to be independent of each other. The preliminary goods are always specific to the production process of a particular final good and are of no use outside their value chains.[21]

[21] A similar representation of the production process has been used by Dixit and Grossman (1982).

3.2.3 Final good producers vs. preliminary good producers

There are a large number of potential firms whose role is to perform these production tasks. Each of these firms owns the trademark rights of a different final good, giving the firm the exclusive right to perform the final task v in the value chain of this final good.[22] All other tasks $z \in [0, v)$ can be performed by all firms without restrictions. Firms can choose between producing their own final product (i.e. becoming final good producers) or performing tasks outsourced by other firms (i.e. becoming preliminary good producers). As final good producers, they transform a preliminary good into the final good they own the trademark rights to. As preliminary good producers, they transform a preliminary good into a more downstream one. As will become clear, free entry drives profits down to zero for both types of producers, so that firms are indifferent between both options in equilibrium.

3.2.4 Costs and core competencies

Firms are symmetric in all other aspects of the production technology. To start operating, they have to incur a fixed cost f which is measured in terms of labour. This fixed cost is associated with acquiring a core competency k in a value chain. The role of this core competency is reflected in the structure of variable costs. The labour requirement of performing one unit of each task in the range $[w_1, w_2]$ in this value chain is given by

$$l(w_1, w_2) = \frac{1}{2} \int_{w_1}^{w_2} c(|k - z|)\, dz \qquad (25)$$

[22] This final task can be thought of as turning a relatively generic product into a particular brand.

where $c'(.) > 0$, so that firms get the worse at performing a given task the further away it is from their core competency.[23] Firms can only acquire one core competency so that a core competency is the defining feature of a firm. Firms can choose, however, which core competency to acquire and which value chain to invest in.

3.2.5 Outsourcing contracts and the vertical division of labour

The vertical division of labour in each value chain is determined in the following bargaining game. There are two stages, a contracting stage and a production stage, and both stages are divided into a sequence of substages.

Contracting stage Consider first the contracting stage. In the first substage, the final good producer enters, chooses a core competency, and incurs the associated fixed costs. Then she decides whether to perform all tasks $z \in [0, v]$ required to produce the final good in-house, or to tender a take-it-or-leave-it outsourcing contract, offering to purchase y_{n_s} units of preliminary good w_{n_s} at price p_{n_s}, where y_{n_s}, w_{n_s}, and p_{n_s} are choice variables.[24] If she decides to perform all tasks in-house, the contracting stage ends. If she decides to tender an outsourcing contract and this outsourcing contract is not accepted by any firm, she either performs all tasks in-house or exits. If, on the other hand, she decides to tender an outsourcing contract and this outsourcing contract is signed by a preliminary good producer, the second substage begins. This second substage is essentially a repetition of the first substage.

[23] Notice that this is the labour requirement of transforming one unit of preliminary good w_1 into one unit of preliminary good w_2.

[24] Notice that she can do so because she has the exclusive right to perform the final task v, and preliminary goods are specific to the production process of a particular final good.

First, the preliminary good producer enters, chooses a core competency, and incurs the associated fixed costs. Then she decides whether to perform all tasks $z \in [0, w_{n_s}]$ required to produce preliminary good w_{n_s} in-house, or to tender another take-it-or-leave-it outsourcing contract, offering to purchase y_{n_s-1} units of the more upstream preliminary good w_{n_s-1} at price p_{n_s-1}, where y_{n_s-1}, w_{n_s-1}, and p_{n_s-1} are again choice variables. If she decides to perform all tasks in-house, the contracting stage ends. If she decides to tender an outsourcing contract and this outsourcing contract is not accepted by any firm, she is forced to produce the agreed upon quantity of preliminary good w_{n_s} in-house. If, on the other hand, she decides to tender an outsourcing contract and this outsourcing contract is signed by another preliminary good producer, the third substage begins. This process continues until in some substage a preliminary good producer decides to perform all remaining tasks in-house. In all substages, contracts are assumed to be complete and perfectly enforceable. Also, there is free entry of potential firms, so that outsourcing offers are going to be accepted as long as they imply non-negative profits.

Production stage Consider now the production stage which follows after the contracting stage ends. The production stage is simply the execution of the production process as agreed upon in the contracting stage, taking into account the sequentiality of the production process. Hence, the most upstream preliminary good producer produces the agreed upon quantity of the agreed upon preliminary product by sequentially performing the required tasks and sells it to the second most upstream preliminary good producer at the agreed upon price and so on until all tasks have been performed and the final good is produced.

3.3 Optimal organization of production

As will turn out, this game has a unique subgame perfect Nash equilibrium. In this equilibrium, the final good producer chooses her actions to maximize her profits subject to the actions she can expect to be chosen by the preliminary good producers after eliminating non-credible threats. As always, profit maximization implies cost minimization, and it is useful to consider both in turn. The solution to the cost minimization problem will be derived in the following subsection. The solution to the profit maximization problem will be discussed thereafter.

3.3.1 Cost minimization

To solve the cost minimization problem, I proceed in two steps. First, I take a social planner's perspective and derive the division of labour between firms which ensures that total production costs of the final good are minimized for a given level of output. Then, I turn to the decentralized case. As will become clear later, the decentralized equilibrium is easy to characterize in view of the solution to the social planner's problem, given the strong bargaining position of the final good producer in the bargaining game.

First step: solving the social planner's problem Consider thus a social planner who is in full control of the final good producer and all potential preliminary good producers. How many firms should participate in the production process of the final good, which core competencies should they acquire, and which tasks should each firm perform in order to minimize the total cost of producing y units of the final good? This problem will be solved in a number of steps.

Consider first an arbitrary number of firms with an arbitrary distribution of core competencies. To minimize total production costs, which firm should perform which set of tasks? Since the fixed costs have to be incurred irrespective of the organization of production, they are irrelevant for the solution to this problem. For total cost minimization, the aim should thus be to minimize the total unit labour requirement. Consider figure (3) which plots $\frac{1}{2}c(|k-z|)$ for an arbitrary number of firms and an arbitrary distribution of core competencies.[25] In this figure, the total unit labour requirement is represented by the total area under all triangles. As can be easily seen, this area is minimized if each firm performs the task which exactly matches its core competency plus all the tasks to both sides of this core competency until half-way between this firm's core competency and the neighbouring firm's core competency.

Consider now the optimal distribution of core competencies. Elementary geometry reveals that the total area under all triangles is minimized if the firms' core competencies are distributed uniformly along the value chain. Hence, for total cost minimization each firm should be of the same vertical size and perform a symmetric range of tasks around its core competency.

Finally, consider the optimal vertical firm size conditional on a given level of output $s(y)$. Since all tasks $z \in [0, v]$ have to be performed to produce the final product, this is equivalent to considering the optimal number of firms in this value chain conditional on a given level of output $n_s(y)$, where

[25] To keep the illustration simple, $c(.)$ is drawn as a linear function with $c(0) = 0$ in this figure. All results carry over to the more general case, however.

$n_s(y) = \frac{v}{s(y)}$.[26] For given vertical and horizontal firm sizes s and y, each firm has a labour requirement of

$$l = f + \left[\int_0^{\frac{s}{2}} c(z)\, dz\right] y \tag{26}$$

as can be inferred easily from equation (25) and figure (3).[27] Defining $C\left(\frac{s}{2}\right) \equiv \int_0^{\frac{s}{2}} c(z)\, dz$ this can be written as

$$l = f + yC\left(\frac{s}{2}\right) \tag{27}$$

Notice that $C'(.) \equiv c(.)$ from the above definition of $C(.)$. Since there are $\frac{v}{s}$ firms involved in the production of the given final good, the total labour requirement is given by $\frac{v}{s}l$. Since labour is paid a wage rate ω, total production costs are

$$TC = \frac{\omega v}{s} f + \frac{\omega v}{s} yC\left(\frac{s}{2}\right) \tag{28}$$

Minimizing this expression with respect to s yields the first order condition

$$f = y\left[\frac{1}{2} sc\left(\frac{s}{2}\right) - C\left(\frac{s}{2}\right)\right] \tag{29}$$

which implicitly defines $s(y)$.[28] It is straightforward to show that this implies[29]

$$s'(y) < 0 \tag{30}$$

[26] v is assumed to be sufficiently large relative to $s(y)$ so that the integer problem can be ignored.

[27] Notice that the above result that firms should be of the same vertical size and perform a symmetric range of tasks around their core competencies is incorporated in this expression.

[28] It can be easily checked that the second order condition for cost minimization is also satisfied.

[29] From equation (29) it follows that $s'(y) = -\frac{4f}{y^2 sc'\left(\frac{s}{2}\right)}$ which is negative since $c'\left(\frac{s}{2}\right) > 0$.

Hence, vertical and horizontal firm size are negatively related if total production costs are to be minimized. Underlying this result is a trade-off between fixed and variable total production costs. If output is large, variable costs become more important relative to fixed costs so that it is efficient to incur additional fixed costs and set up more firms which can then operate at a smaller vertical scale in order to achieve lower variable production costs. Given the optimal firm size $s(y)$, the optimal labour requirement of each firm $l(y)$ then follows straightforwardly from equation (27).

In summary, total production costs are thus minimized if each task is performed by only one firm, all firms are of size $s(y)$ and perform a symmetric range of tasks around their core competencies.

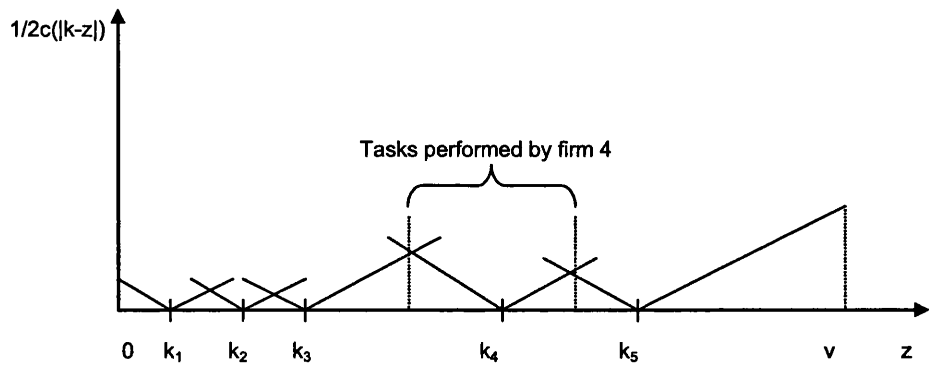

Figure 3: Vertical equilibrium

Second step: solving for the decentralized equilibrium Given the strong bargaining position of the final good producer in the bargaining game, the decentralized equilibrium is easy to characterize in view of this solution to the social planner's problem. In fact, the subgame perfect Nash equilibrium of the bargaining game exactly replicates the solution to the social planner's problem in terms of the number of vertically related firms, the location of their core competencies, and the range and quantity of tasks they perform. As for the equilibrium outsourcing contracts, they are such that all preliminary good producers make zero profits. In terms of the above notation, the final good producer thus performs y units of the final $s(y)$ tasks in-house and buys y units of preliminary product $v - s(y)$ at price $\omega [n_s(y) - 1] l(y)$ from a preliminary good producer. This preliminary good producer purchases y units of preliminary product $v-2s(y)$ at price $\omega [n_s(y) - 2] l(y)$ from yet another preliminary good producer and so on. Finally, the second most upstream firm in the value chain purchases y units of preliminary product $v - [n_s(y) - 1] s(y) = s(y)$ at price $\omega [n_s(y) - (n_s(y) - 1)] l(y) = \omega l(y)$ from the most upstream firm. To verify that this is the subgame perfect Nash equilibrium of the bargaining game, proceed by backwards induction. Consider first the production stage. Given the assumption that contracts are complete and perfectly enforceable, firms cannot deviate in the production stage. Consider now the contracting stage. Notice first that in all substages no preliminary good producer has an incentive to deviate in any action since only the described actions are consistent with zero profits (in other words, the preliminary good producers' participation constraints are binding). Notice second that the final good producer does not have an incentive to deviate since the described actions allow her to produce y units of the final good at minimum possible costs. Hence, this is indeed a subgame perfect Nash equilibrium of the bargaining game. Clearly, it is also the only one.

Since all firms are assumed to be able to become final good producers for some final good, the above argument only goes through if the final good producer also makes zero profits in equilibrium. This will be ensured through monopolistic product market competition as will be laid out in a later section.

3.3.2 Profit maximization

Consider now the profit maximization problem of the final good producer. Given the equilibrium outsourcing contract, the final good producer's total cost function is given by

$$TC(y) = \frac{1}{2}\omega vyc\left(\frac{s(y)}{2}\right) \tag{31}$$

This is just the expression for the minimum possible total production cost as follows from equations (28) and (29). Some manipulation reveals that the final good producer's marginal costs are given by

$$MC(y) = \frac{1}{s(y)}\omega vC\left(\frac{s(y)}{2}\right) \tag{32}$$

Consider now the demand facing the final good producer. In a setting of monopolistic competition, the demand elasticity perceived by the final good producer is exactly as derived above from consumer choice (see equation (24)). As is well known, profit maximization implies that firms charge a mark-up $m(x)$ over marginal costs, where

$$m(x) = \frac{1}{\varepsilon(x) - 1} \tag{33}$$

Notice that $m'(x) > 0$ since $\varepsilon'(x) < 0$ and that $m(0) < \gamma$ since $\varepsilon(0) > \frac{1+\gamma}{\gamma}$. Of course, $y = Lx$ so that

$$\frac{p}{\omega} = \left[1 + m\left(\frac{y}{L}\right)\right] \frac{1}{s(y)} vC\left(\frac{s(y)}{2}\right) \tag{34}$$

This is one of the central equations of the analysis. It describes the pairs $\frac{p}{\omega}$ and y consistent with profit maximization (for this reason, the relationship will be referred to as PMX curve henceforth).

3.4 The zero profit equilibrium

3.4.1 The zero profit condition

The model is closed with a zero profit condition. As long as final good producers make positive profits, new varieties will be established increasing the competition facing each final good producer.[30] Final good producers' average costs are given by

$$AC(y) = \frac{1}{2}\omega vc\left(\frac{s(y)}{2}\right) \tag{35}$$

as follows straightforwardly from equation (31). The zero profit condition can thus be written as

$$\frac{p}{\omega} = \frac{1}{2} vc\left(\frac{s(y)}{2}\right) \tag{36}$$

This is the second central equation of the analysis. It describes the combinations of $\frac{p}{\omega}$ and y where final good producers make zero profits (for this reason,

[30] As indicated above, if final good producers make positive profits the optimal outsourcing contract needs to be altered to induce some firms to become suppliers of preliminary products. Basically, the price offered for each intermediate good would have to be increased until firms are indifferent between becoming a final good producer or a supplier of a preliminary good. The conclusions regarding the zero profit equilibrium are, of course, unaffected by this consideration.

the relationship will be referred to as ZPC curve henceforth).

3.4.2 The ZPC curve as an indicator of labour productivity

Notice that the ZPC curve also captures inverse labour productivity. To see this, recall that each firm in the value chain contributes an equal number of tasks to the production of the final product. Hence, $\frac{y}{n_s(y)}$ units of output can be attributed to the work of a single firm and labour productivity is simply given by $\frac{y}{n_s(y)l(y)}$. Now remember that the ZPC curve is defined as $\frac{AC(y)}{\omega}$. From equation (28) it follows that

$$\frac{AC(y)}{\omega} = \frac{n_s(y)}{y}\left[f + yC\left(\frac{s(y)}{2}\right)\right] \tag{37}$$

which, together with equation (27), implies that

$$\frac{AC(y)}{\omega} = \frac{n_s(y)\,l(y)}{y} \tag{38}$$

This observation will be useful later on in the analysis.

3.4.3 Existence, stability and uniqueness

The PMX curve and the ZPC curve are two equations in the two unknowns $\frac{p}{\omega}$ and y. For an equilibrium to exist, the PMX curve and the ZPC curve must intersect. For an equilibrium to be stable, the ZPC curve must intersect the PMX curve from above, as depicted in figure (4). Then entry of final good producers will shift the demand curve to the left whenever y is to the right of the intersection and exit of final good producers will shift the demand curve to the right whenever y is to the left of the intersection. For an equilibrium to be unique, the ZPC curve must only intersect the PMX curve once.

Some more structure needs to be imposed on the model to ensure that an equilibrium exists, is stable and unique. A particularly useful restriction sufficient to guarantee existence, stability and uniqueness is to impose

$$\frac{c\left(\frac{s}{2}\right)}{2} \equiv (1+\gamma)\,\frac{C\left(\frac{s}{2}\right)}{s} \tag{39}$$

As can be seen from equations (32) and (35), this restriction ensures that average and marginal costs are proportional, the factor of proportionality being $(1+\gamma)$,

$$AC = (1+\gamma)\,MC \tag{40}$$

Since $s'(y) < 0$ and $c'\left(\frac{s}{2}\right) > 0$, average costs are decreasing in y. It is easy to show that marginal costs are also decreasing in y.[31] Of course, the marginal cost curve must be strictly below the average cost curve in that case. $m(0) < \gamma$ implies that the PMX curve will be strictly below the ZPC curve at $y = 0$. Since $m'(y) > 0$, the PMX curve will fall less than proportionately relative to the marginal cost curve as y increases.[32] If marginal costs and average costs are proportional, this implies that ZPC intersects PMX only once and from above.

Notice that the above restriction is equivalent to imposing

$$c(.) = \lambda\,(.)^{\gamma}, \quad \lambda > 0, \quad \gamma > 0 \tag{41}$$

[31] $\frac{\partial MC}{\partial y} = \frac{\omega v s'(y)}{s^2}\left[\frac{1}{2}sc\left(\frac{s}{2}\right) - C\left(\frac{s}{2}\right)\right] = \frac{\omega v s'(y)}{s^2}\frac{f}{y} < 0$ since $s'(y) < 0$.

[32] In fact, if the mark-up increases in output at a sufficient speed, the PMX curve might even become upward sloping.

Since (39) is an identity it can be differentiated so that

$$c'\left(\frac{s}{2}\right) = a\left(\frac{s}{2}\right) c\left(\frac{s}{2}\right) \tag{42}$$

where $a\left(\frac{s}{2}\right) \equiv \frac{\gamma}{\left(\frac{s}{2}\right)}$. This is a simple linear first-order differential equation with general solution

$$c\left(\frac{s}{2}\right) = \lambda \left(\frac{s}{2}\right)^{\gamma} \tag{43}$$

Since $c'(.) > 0$ was required, $\lambda > 0$, $\gamma > 0$. This restriction will be imposed henceforth.

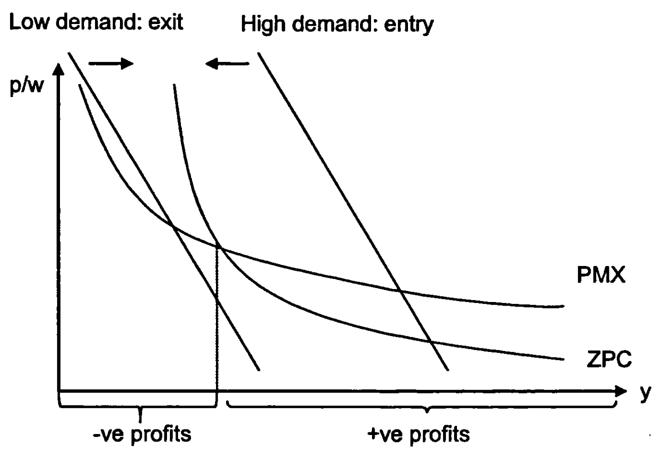

Figure 4: Horizontal equilibrium

3.4.4 Solving for the general equilibrium

The equilibrium values $\left(\frac{p}{\omega}\right)^*$ and y^* are thus determined by ZPC and PMX. The equilibrium vertical firm size s^* then follows from (29), equilibrium consumption per worker is given by $x^* = y^*/L$. Equilibrium employment per firm l^* is determined by (27), the equilibrium number of firms per value chain can be calculated from $n_s^* = v/s^*$. Given the symmetry of the preference structure, $x_i = x$ and $p_i = p$ for all i in equilibrium, so that the consumers' budget constraints simplify to $n_y px = w$. This equation then determines the number of goods n_y^*. Finally, the total number of firms is given by $n^* = n_s^* n_y^*$.

3.4.5 Introduction of comparative statics

With this framework at hand, one can analyse the effect of the exogenous variables L, v, f, λ and γ on the endogenous variables p/ω, s, y, x, l, n_s, n_y and n. This exercise is simplified considerably by the proportionality assumption (39). Since $AC = (1+\gamma) MC$ and, in equilibrium, $AC = \left[1 + m\left(\frac{y^*}{L}\right)\right] MC$ one obtains

$$m\left(\frac{y^*}{L}\right) = \gamma \tag{44}$$

For a given function $m(.)$, y is determined by L and γ only. Since $x^* = y/L$, x^* depends on γ only. Firm labour demand is given by (27). Imposing $c(.) = \lambda (.)^\gamma$ it is easy to show that

$$l^* = f\left(1 + \frac{1}{\gamma}\right) \tag{45}$$

Therefore, firm labour demand depends on f and γ only.

3.4.6 Trade liberalization

Focusing on core competencies Consider first a move from autarky to free trade, which is equivalent to an increase in the labour force in this model. If two identical countries of the type outlined above move from autarky to free trade, the effect is simply a doubling of the labour force. Globalization is often referred to by the business press as forcing firms to focus on their core competencies which is exactly what the model predicts. The effect of trade liberalization on $\frac{p}{w}$, y and s is depicted in figure (5) which plots the PMX and ZPC schedules as well as $s(y)$ as defined by equation (29). As can be seen from equations (29), (34), and (36), an increase in the labour force shifts the PMX curve down while leaving the other curves unchanged. Trade liberalization thus leads to an increase in real wage and output but to a decrease in vertical firm size. In the model, the larger market toughens competition by increasing the demand elasticity facing the final good producers. Final good producers respond to this by reducing their mark-ups and increasing their outputs. These increased outputs make variable costs more important relative to fixed costs so that, in equilibrium, firms will downsize to achieve a more efficient vertical scale. Firms will concentrate on their core competencies, i.e. cover a smaller segment of the value chain, as they expand horizontally. Trade liberalization is thus associated with outsourcing in this framework. Since there are no trade costs in the model and countries are assumed to be symmetric, there is no explicit distinction between the home country and the foreign country. Whether outsourcing occurs domestically or internationally ('offshoring') is hence indeterminate in this model.

Productivity effect Notice that trade liberalization leads to an increase in firm productivity, as the equilibrium point moves down the ZPC curve (recall that the ZPC curve also captures inverse labour productivity). Underlying this productivity effect is an increasing returns to scale effect and an outsourcing effect. This is depicted in figure (6). The increasing returns to scale effect is the productivity effect which would occur if vertical firm size

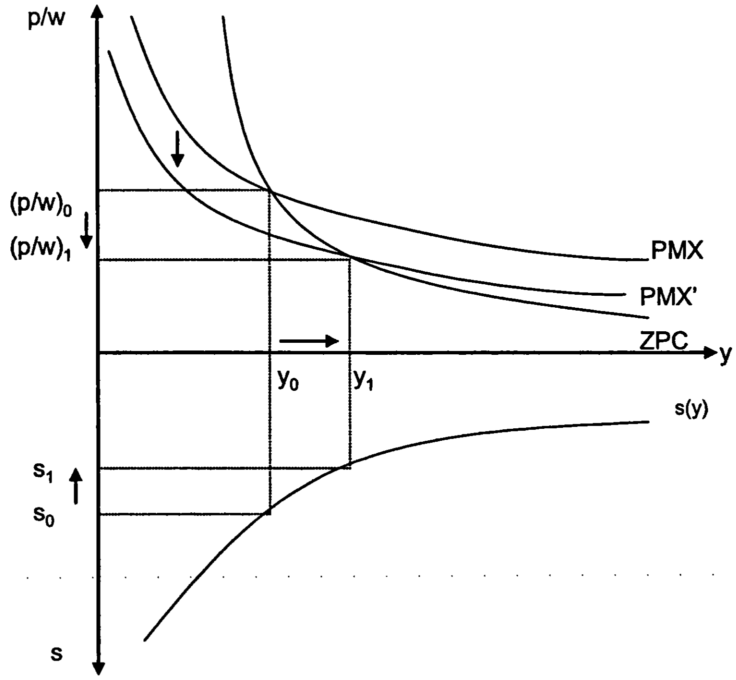

Figure 5: Trade liberalization

was fixed. The outsourcing effect is the additional productivity effect brought about by the endogeneity of vertical firm size. Consider first the construction of the ZPC schedules in figure (6). Suppose that vertical firm size is fixed at an arbitrary level $\tilde{s}$.[33] Since $s(y)$ minimizes $TC(y)$ and hence also $AC(y)$ with respect to s, this $\tilde{s}$ is suboptimal unless $y = \widetilde{y}$, where $\widetilde{y}$ is implicitly defined by $\tilde{s} = s(\widetilde{y})$. Therefore, the average cost curve of the restricted model must be strictly above the average cost curve of the unrestricted model, unless $y = \widetilde{y}$ and both curves coincide. As the ZPC curves are proportional to the average cost curves, the ZPC curve of the restricted model must thus also be strictly above the ZPC curve of the unrestricted model unless $y = \widetilde{y}$, as drawn in figure (6). Suppose now that the initial equilibrium is at $y = \widetilde{y}$ and

[33]Notice that the model then essentially reduces to Krugman (1979). As can be seen from equation (7), a final good producer then has a constant fixed cost $\frac{wv}{\tilde{s}}f$ and a constant marginal cost $\frac{wv}{\tilde{s}}C\left(\frac{\tilde{s}}{2}\right)$, just as in Krugman (1979).

consider the impact of a trade liberalization. It is easy to show that the output response to the trade liberalization is larger in the unrestricted case than in the restricted case. This is because marginal costs are decreasing rather than constant in output in the unrestricted case. The increasing returns to scale effect is captured by the distance between A and B in figure (6), whereas the outsourcing effect is given by the distance between B and C. Hence, there is a genuine outsourcing effect in this model which goes beyond the traditional increasing returns to scale effect.

Other effects The effects on the remaining endogenous variables are as follows. The number of varieties available to consumers increases, while consumption per worker per final good is unchanged. Due to the reduced vertical firm sizes, the number of firms within each value chain increases. Interestingly, the number of workers hired by each individual firm is unaffected so that firm scale only changes as measured by output. Therefore, the total number of firms operating in each country remains unchanged. Hence, despite a reduction in the number of varieties produced in each country, trade liberalization does not lead to net exit of domestic firms in this model.

3.4.7 Decreasing the length of the value chain/technological progress

Consider now a reduction in the length of the value chain. Since a shorter value chain implies that fewer tasks need to be performed to manufacture the final product, this change can be interpreted as reflecting technological progress. The effect of a change in v on $\left(\frac{p}{w}\right)^*$, y^* and s^* is depicted in figure (7). $\left(\frac{p}{w}\right)^*$ decreases by the same proportion as v but y^* and s^* are unchanged. As can be verified easily, x^*, l^* are also unchanged. n_y^* increases by the same

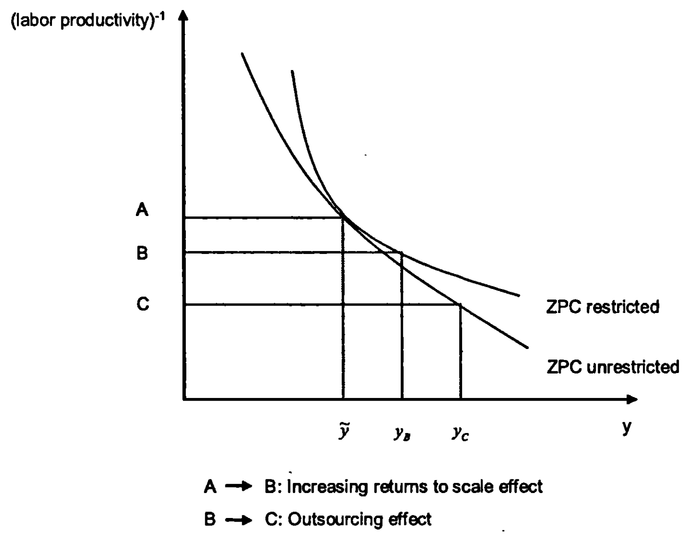

Figure 6: Decomposition of productivity effects

proportion as v falls but n_s^* falls by the same proportion as v falls so that the total number of firms remains unchanged.

3.4.8 Changes in the cost structure

To analyse changes in the cost structure it is useful to express the ZPC curve and the PMX curve explicitly in terms of the cost parameters. Substituting restriction (43) into the first order condition (29) and rearranging yields

$$s(y) = 2\left[\frac{f(1+\gamma)}{y\gamma\lambda}\right]^{\frac{1}{1+\gamma}} \tag{46}$$

Using this result in equations (36) and (34) yields the following expressions for the ZPC- curve and the PMX curve, respectively,

$$\frac{p}{\omega} = \frac{v}{2}(\lambda)^{\frac{1}{1+\gamma}}\left[\frac{f(1+\gamma)}{y\gamma}\right]^{\frac{\gamma}{1+\gamma}} \tag{47}$$

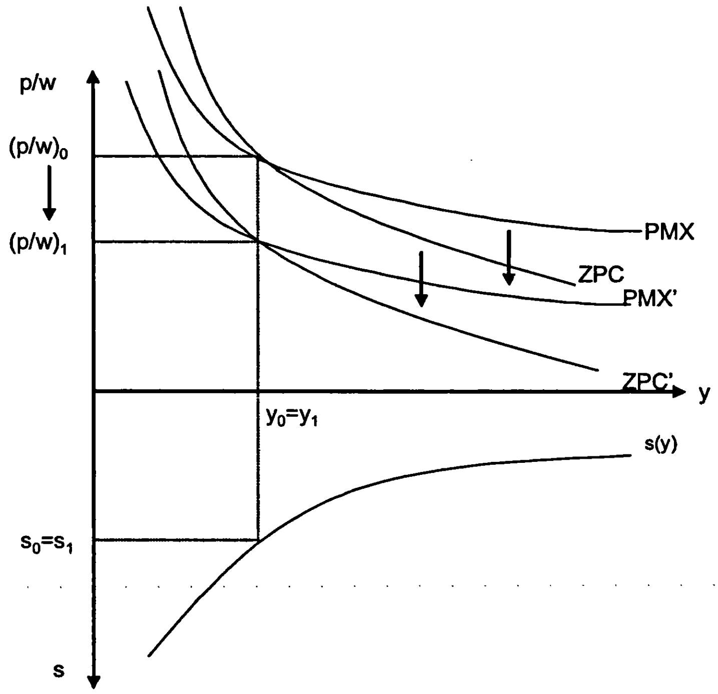

Figure 7: Technological progress

$$\frac{p}{\omega} = \frac{v}{2}\left[1 + m\left(\frac{y}{L}\right)\right]\left[\frac{\lambda}{1+\gamma}\right]^{\frac{1}{1+\gamma}}\left[\frac{f}{y\gamma}\right]^{\frac{\gamma}{1+\gamma}} \tag{48}$$

Changes in fixed costs The effect of an increase in fixed costs on the real wage as well as horizontal and vertical firm size is depicted in figure (8). As can be seen from equations (46-48), an increase in f shifts up the PMX curve and the ZPC curve by the same proportion and shifts down $s(y)$. Hence, the real wage falls, output per firm stays constant and firms get larger horizontally. The insourcing, of course, comes along with a fall in the number of firms per value chain, which is exactly what one would expect following an increase in fixed costs. Of course, this implies that each firm has to cover a longer segment of the value chain so that, on average, tasks are further away from the firms' core competencies causing higher aggregate variable costs. Consumption per final good remains unchanged, each firm hires more workers, the number of varieties falls and so does the total number of firms.

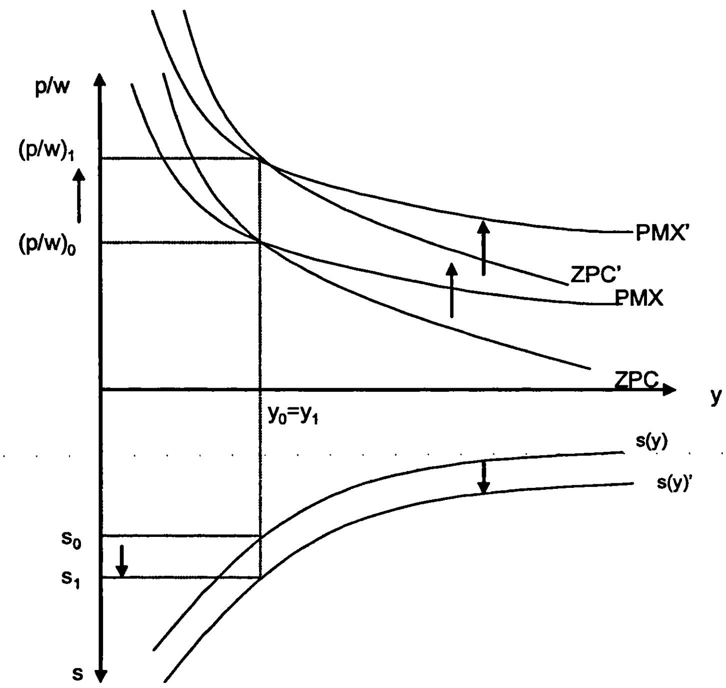

Figure 8: Increased fixed production costs

Changes in governance costs Consider first an increase in λ. As shown in figure (9) this decreases real wage and vertical firm size but leaves output per firm unaffected. Again, the decrease in vertical firm size is exactly what one would expect to happen in response to an increase in this component of internal governance costs. Consumption per final good is unaffected and so is the number of workers hired by each firm. The number of firms per value chain increases but the number of varieties decreases at the same proportion so that the total number of firms is unaffected.

Consider now an increase in γ. The effect on both the PMX curve as well as the ZPC curve is ambiguous, so a graphical illustration as above is not very insightful. From equation (44) it is clear, however, that y^* increases, from equation (45) it follows that l^* falls. Since L is unchanged, x^* will increase with y^*. Differentiating (46) reveals that s^* falls and hence n_s^* rises. As expected, an increase in this component of internal governance costs hence triggers outsourcing to save on marginal costs. The effect on $\left(\frac{\omega}{p}\right)^*$, n_y^* and n^* is ambiguous.

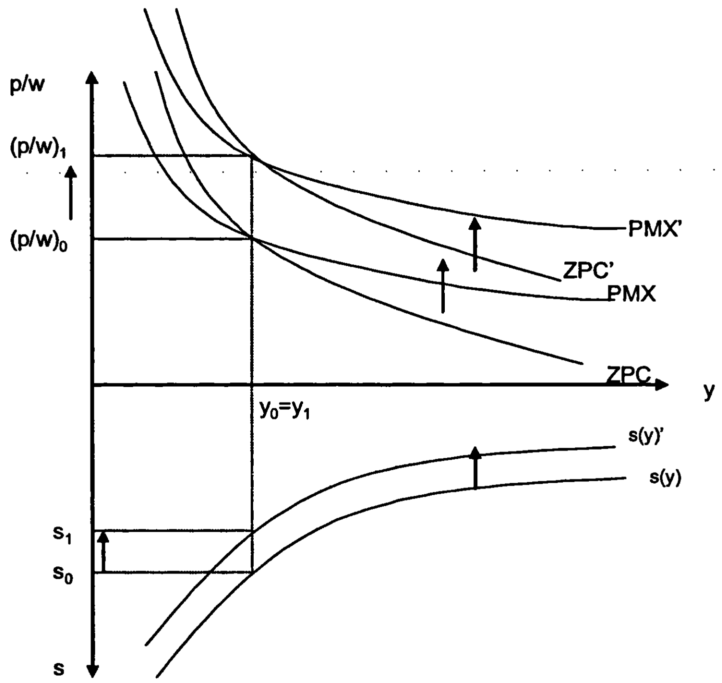

Figure 9: Increased internal governance costs

3.5 Conclusion

In this chapter, I developed a simple general equilibrium model of trade in which trade liberalization leads to outsourcing as firms focus on their core competencies in response to tougher competition. Since firms are better at performing tasks the closer they are to their core competencies, this outsourcing increases firm productivity. Besides establishing this result, I also investigated the links between various technological parameters and outsourcing. In particular, I analysed how technological progress, changes in fixed costs, and changes in internal governance costs affect firms' integration decisions.

Essentially, the model relates Adam Smith's famous proposition that the division of labour is limited by the extent of the market to the topic of vertical integration. The larger the market, the more important become variable costs relative to fixed costs in the model so that, in equilibrium, the production tasks are divided among a larger number of leaner vertically related firm.

So far, the focusing on core competencies is just a plausible channel through which trade liberalization may affect firm productivity. To substantiate the importance of that link, rigorous empirical research is now required. Given that trade-induced increases in firm productivity have been found in several empirical studies, this seems to be a promising project for future work in this area.

4 A 'New Trade' Theory of GATT/WTO Negotiations

4.1 Introduction

"Without cooperation, we will be lost. Without institutions there will be little cooperation. And without a knowledge of how institutions work – and what makes them work well – there are likely to be fewer, and worse, institutions than if such knowledge is widespread". Robert O. Keohane[34]

International trade has been liberalized dramatically during the past half-century. Since the end of World War II, the average ad valorem tariff on manufacturing goods has been reduced from over 40 percent to below 4 percent, making this undoubtedly one of the most important ever acts of economic policy making.

It is widely agreed that this liberalization was largely the result of a sequence of successful 'rounds' of trade negotiations governed by the General Agreement on Tariffs and Trade (GATT) and later its successor the World Trade Organization (WTO). The GATT/WTO is an institution regulating trade negotiations through a number of specific articles. The principles of reciprocity and nondiscrimination are generally considered to be the essence of these articles. The former requires that trade policy changes keep changes in import volumes equal across trading partners. The latter stipulates that the same tariff must be applied against all trading partners for any given traded product.[35]

[34]Robert O. Keohane is a leading American international relations theorist. This quote is taken from Gruber (2000).

[35]I adopt here Bagwell and Staiger's (1999) interpretation of the rules of reciprocity and

Against this background, I address the following two questions in this chapter: first, why was the GATT/WTO so successful in achieving trade liberalization? And second, what was the role played by the principles of reciprocity and nondiscrimination?

As is well-known, the neoclassical theory of trade negotiations already offers standard answers to these questions. Its main argument was developed by Johnson (1953-1954) and later formulated in modern game-theoretic terms by Mayer (1981): in a neoclassical environment, large countries have an incentive to impose import tariffs to improve their terms-of-trade vis-à-vis their trading partners. However, if all countries impose import tariffs to improve their terms-of-trade, no country actually succeeds and inefficiently high tariffs prevail. The purpose of GATT/WTO negotiations is then to bargain over a reduction in these inefficiently high tariffs. While this main argument established the need for trade negotiations, it remained silent about the role of reciprocity and nondiscrimination. This was then rectified by Bagwell and Staiger (1999), who demonstrated how these principles can be interpreted as useful bargaining rules which help countries escape such a terms-of-trade driven Prisoners' dilemma.[36]

However, this standard theory has two major shortcomings. First, it is inconsistent with the actual GATT/WTO agreement in one important dimension. In particular, the GATT/WTO does not constrain the use of export taxes

nondiscrimination. For a detailed discussion of how this interpretation is derived from GATT/WTO articles, see chapter 3 of Bagwell and Staiger (2002).

[36] An alternative theory of multilateral trade agreements is provided by Maggi (1999). It emphasizes enforcement considerations, arguing that lower tariffs can be enforced if multilateral retaliation is possible. Another alternative theory of trade agreements (bilateral or multilateral) is offered by Maggi and Rodriguez-Clare (1998 and forthcoming). It stresses commitment considerations, pointing out that trade agreements may help governments commit vis-à-vis domestic special interest groups. However, neither of these theories focuses on the detailed principles of GATT/WTO negotiations which is the topic of the present chapter.

and therefore does not prevent countries from influencing their terms-of-trade. This is because, by Lerner symmetry, import tariffs and export taxes have exactly the same effects in general equilibrium.[37] Hence, if countries' trade policy choices were really driven by a desire to influence their terms-of-trade, the GATT/WTO should lead to a widespread use of export taxes. This is, however, not observed in practice (see Ethier 2002 for a vivid discussion of that inconsistency). Second, many economists simply feel that real-world trade negotiations are not about preventing terms-of-trade manipulations. Krugman (1997), for example, writes that "this optimal tariff argument plays almost no role in real-world trade disputes". Instead, securing foreign market access seems to be the core concern of policy makers. Bagwell and Staiger (1999), for example, quote the following passage from a GATT panel report: "... the main value of a tariff concession is that it provides better market access".

In this chapter, I address these two shortcomings. Thus, I develop a novel theory of GATT/WTO negotiations which is consistent with the fact that export taxes are not constrained by the GATT/WTO. Moreover, it does not rely on the terms-of-trade mechanism but more directly emphasizes market access considerations. To achieve this, I consider trade negotiations in a monopolistically competitive environment. I first argue that tariffs are inefficiently high in the non-cooperative equilibrium because countries attempt to improve their relative market access at the expense of other countries in order to attract manufacturing firms from abroad. I then show how GATT/WTO negotiations can help countries overcome this inefficiency by providing new rationales for

[37] Intuitively, the price of exports relative to imports can be increased either by imposing an import tariff which reduces world demand for the import product thereby making it cheaper, or by imposing an export tax which reduces the world supply of the export product thereby making it more expensive.

the fundamental GATT/WTO principles of reciprocity and nondiscrimination.

The remainder of this chapter is organized as follows. In the next section, I develop the basic two-country model and use this model to establish that the non-cooperative equilibrium is inefficient and demonstrate how trade negotiations governed by the principle of reciprocity help countries attain an efficient outcome. In the third section, I then develop a three-country extension of this basic model and use this extended model to evaluate the joint functioning of the principles of reciprocity and nondiscrimination. A final section concludes.

4.2 The basic model

4.2.1 Setup

The basic model is a variant of the standard Krugman (1980) 'new trade' model with transport costs. There are two countries: Home and Foreign. Variables relating to Foreign are identified by an asterisk. Consumers have access to a continuum of differentiated manufacturing goods and a single homogeneous 'outside good'. Preferences over these goods are identical in both countries. They are given by the following utility functions

$$U = \left[\int_0^{n+n^*} m(i)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\mu\sigma}{\sigma-1}} Y^{1-\mu}, \qquad \sigma > 1 \tag{49}$$

$$U^* = \left[\int_0^{n+n^*} m^*(j)^{\frac{\sigma-1}{\sigma}} dj \right]^{\frac{\mu\sigma}{\sigma-1}} Y^{*1-\mu}, \qquad \sigma > 1 \tag{50}$$

where $m(i)$ denotes consumption of a differentiated manufacturing good, Y denotes consumption of the homogeneous outside good, n is the 'number' of manufacturing goods produced, σ is the elasticity of substitution between manufacturing goods, and μ is the share of income spent on manufacturing goods. Technologies are also identical in both countries. They are summarized by the following (inverse) production functions

$$l^M = f + cq^M \tag{51}$$

$$l^{*M} = f + cq^{*M} \tag{52}$$

$$l^Y = q^Y \tag{53}$$

$$l^{*Y} = q^{*Y} \tag{54}$$

where l^M (l^Y) is the labour requirement for producing q^M (q^Y) units of a manufacturing good (the outside good), and f (c) denotes the fixed (marginal) labour requirement of manufacturing production. The manufacturing goods market is monopolistically competitive whereas the outside good market is perfectly competitive. Trade costs only apply to manufacturing goods and take the familiar 'iceberg' form. These 'iceberg' trade costs are denoted by ϕ. They are further decomposed into 'iceberg' transport costs θ, which are identical across countries, and 'iceberg' tariffs τ, which may be different across countries, so that

$$\phi = \theta + \tau, \qquad \theta > 1,\ \tau \geq 0 \tag{55}$$

$$\phi^* = \theta + \tau^*, \qquad \theta > 1,\ \tau^* \geq 0 \tag{56}$$

These 'iceberg' tariffs are the only new addition to the model. Their 'iceberg' nature helps preserve the model's tractability because like that no tariff revenue is generated. For simplicity, I also make the following three additional assumptions: first, I assume that Home and Foreign are of equal size and are both inhabited by L workers/consumers. Second, I assume that the outside good sector is always active in both countries. This is ensured for all possible (τ, τ^*) if and only if demand for manufacturing goods is sufficiently small: $\mu < \frac{1}{2}$ (see appendix A1 for details). Third, I assume that the manufacturing sector is always active in both countries. This is ensured for all possible (τ, τ^*) if and only if transport costs are sufficiently large: $\theta > \left(\frac{1}{2}\right)^{\frac{1}{1-\sigma}}$ (see again appendix A1 for details).

4.2.2 No trade policy

Consider now the equilibrium at Home and Foreign, exogenously fixing tariffs at some level. Choose $p^Y = 1$ and notice that this implies $w = w^* = 1$, where w is the wage rate, since the outside good sector is always active in both countries, the outside good market is perfectly competitive, the outside good is produced using the above technology, and is freely traded among countries. As is well-known, utility maximization with the above preferences then yields the following demands for the outside good

$$Y = (1 - \mu) L \tag{57}$$

$$Y^* = (1 - \mu) L \tag{58}$$

and the following demands for each manufacturing good

$$m(i) + m^*(i) = \mu L \frac{p(i)^{-\sigma}}{G^{1-\sigma}} + \mu L \phi^{*1-\sigma} \frac{p(i)^{-\sigma}}{G^{*1-\sigma}} \tag{59}$$

$$m(j) + m^*(j) = \mu L \phi^{1-\sigma} \frac{p^*(j)^{-\sigma}}{G^{1-\sigma}} + \mu L \frac{p^*(j)^{-\sigma}}{G^{*1-\sigma}} \tag{60}$$

where the former is the demand facing a Home manufacturing firm, the latter is the demand facing a Foreign manufacturing firm, $p(i)$ denotes the ex-factory price of a manufacturing good, and the price indices are given by

$$G = \left[\int_0^n p(i)^{1-\sigma} \, di + \int_0^{n^*} [\phi p^*(j)]^{1-\sigma} \, dj \right]^{\frac{1}{1-\sigma}} \tag{61}$$

$$G^* = \left[\int_0^n [\phi^* p(i)]^{1-\sigma} \, di + \int_0^{n^*} p^*(j)^{1-\sigma} \, dj \right]^{\frac{1}{1-\sigma}} \tag{62}$$

Since these manufacturing demand functions have a constant price elasticity of σ, profit-maximization implies that manufacturing firms charge a constant mark-up over marginal costs so that

$$p(i) = p^*(j) = \frac{\sigma c}{\sigma - 1} \equiv p \tag{63}$$

which implies that the price indices simplify to

$$G = p \left[n + n^* \phi^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \tag{64}$$

$$G^* = p \left[n \phi^{*1-\sigma} + n^* \right]^{\frac{1}{1-\sigma}} \tag{65}$$

Free entry drives manufacturing firms' profits down to zero leading to the following break-even outputs

$$q = q^* = \frac{f(\sigma - 1)}{c} \tag{66}$$

and hence the following break-even labour demands

$$l = l^* = f\sigma \tag{67}$$

Manufacturing market clearing thus requires

$$q = \mu L \frac{p^{-\sigma}}{G^{1-\sigma}} + \mu L \phi^{*1-\sigma} \frac{p^{-\sigma}}{G^{*1-\sigma}} \tag{68}$$

$$q = \mu L \phi^{1-\sigma} \frac{p^{-\sigma}}{G^{1-\sigma}} + \mu L \frac{p^{-\sigma}}{G^{*1-\sigma}} \tag{69}$$

which can be solved for the equilibrium price indices

$$G = \left[\frac{qp^{\sigma}\left(1 - \phi^{*1-\sigma}\right)}{\mu L \left[1 - (\phi\phi^*)^{1-\sigma}\right]} \right]^{\frac{1}{\sigma-1}} \tag{70}$$

$$G^* = \left[\frac{qp^{\sigma}\left(1 - \phi^{1-\sigma}\right)}{\mu L \left[1 - (\phi\phi^*)^{1-\sigma}\right]} \right]^{\frac{1}{\sigma-1}} \tag{71}$$

These equilibrium price indices can then be solved for the equilibrium numbers of manufacturing firms

$$n = \frac{\mu L}{qp} \left[\frac{1}{1 - \phi^{*1-\sigma}} - \frac{\phi^{1-\sigma}}{1 - \phi^{1-\sigma}} \right] \tag{72}$$

$$n^* = \frac{\mu L}{qp} \left[\frac{1}{1 - \phi^{1-\sigma}} - \frac{\phi^{*1-\sigma}}{1 - \phi^{*1-\sigma}} \right] \tag{73}$$

Notice that this implies that the world number of manufacturing firms is always constant and given by[38]

$$n + n^* = 2\frac{\mu L}{qp} \quad (74)$$

Notice further that, given the above demands, the indirect utility functions are

$$V = \mu^{\mu} (1 - \mu)^{(1-\mu)} LG^{-\mu} \quad (75)$$

$$V^* = \mu^{\mu} (1 - \mu)^{(1-\mu)} LG^{*-\mu} \quad (76)$$

so that each country's welfare is decreasing in its manufacturing price index.

4.2.3 Trade policy

Consider now the governments' tariff choices. I assume throughout that tariffs are set by governments in an attempt to maximize their citizens' welfare. The discussion in this section is structured around four propositions. Proposition 1 summarizes the benchmark case of noncooperative tariffs setting, proposition 2 describes the set of Pareto efficient tariff combinations, and propositions 3 and 4 establish how trade negotiations governed by the principle of reciprocity can help countries attain an efficient outcome:

Proposition 1 *Suppose governments choose tariffs simultaneously, Home maximizing V and Foreign maximizing V^*. Then the only Nash equilibrium tariff combination which is robust to small perturbations in the governments' strate-*

[38]This is because world expenditure on manufacturing goods is constant and given by $2\mu L$ and firm sales are constant and given by qp. This, of course, depends on the particular functional form assumptions made above.

gies (i.e. 'trembling-hand perfect') is $(\tau, \tau^*) = (\infty, \infty)$[39]

Proof. Given the form of V, V is maximized when G is minimized. Also, $\frac{\partial G}{\partial \tau} = -\frac{\phi^*(\phi\phi^*)^{-\sigma}}{[1-(\phi\phi^*)^{1-\sigma}]}G$ so that $\frac{\partial G}{\partial \tau} < 0$ for all $\tau^* \in [0, \infty)$ and $\frac{\partial G}{\partial \tau} = 0$ for $\tau^* = \infty$. Hence, Home maximizes V by choosing $\tau = \infty$ if $\tau^* \in [0, \infty)$ and any possible τ if $\tau^* = \infty$. Similarly, Foreign maximizes V^* by choosing $\tau^* = \infty$ if $\tau \in [0, \infty)$ and any possible τ^* if $\tau = \infty$. Thus, the set of Nash equilibrium tariffs consists of all (τ, τ^*) such that either $(\tau, \tau^*) = (\infty$, any possible $\tau^*)$ or $(\tau, \tau^*) =$ (any possible τ, $\infty)$. However, if the governments' strategies are subject to small perturbations, Home's (Foreign's) best response is always to choose $\tau = \infty$ $(\tau^* = \infty)$. Therefore, $(\tau, \tau^*) = (\infty, \infty)$ is the only Nash equilibrium tariff pair which is robust to small perturbations in the governments' strategies (i.e. 'trembling-hand perfect') ∎

Hence, noncooperative tariff setting leads to autarky. This result arises because each government always has an incentive to unilaterally increase its tariff.[40] The intuition for this is as follows: a unilateral increase in the own tariff increases the relative market access of firms in the own country by reducing the absolute market access of firms in the other country. This makes

[39] Two technical asides: 1) since ∞ is not a number, the correct notation would be $(\tau, \tau^*) \to (\infty, \infty)$. But since such correct notation would unnecessarily complicate the exposition of the proofs below, I consistently avoid it in this paper; 2) since ∞ is not a number, it is somewhat unclear what setting $\tau = \infty$ would mean in practice. This problem could be avoided by assuming that tariffs must be below some finite upper bound $\overline{\tau}$. This modification would leave all results substantially unchanged. However, it would conceal that governments have an incentive to completely choke off manufacturing imports in this model and is therefore not adopted.

[40] Strictly speaking, a country has an incentive to unilaterally increase its tariff only if the other country's tariff is finite. This is because otherwise the own price index becomes independent of the own tariff. The reason for this is as follows: If the other country's tariff is infinity, the own firms are only selling in the own market so that the demands they face depend only on the own price index. Since these demands must be unchanged in equilibrium to ensure that the own firms make zero-profits, a change in the own tariff must therefore also keep the own price index unchanged. This is also why there is a whole set of Nash equilibria so that an equilibrium refinement needs to be imposed.

the own country a relatively more attractive business location thus triggering a relocation of firms towards the own country. This, in turn, reduces the own price index and hence increases the own welfare. This mechanism is sometimes referred to as the 'Venables Effect', since it was first described in Venables (1987). Notice that governments would never impose export taxes in this model. This is because an export tax deteriorates a country's relative market access thereby making firms move abroad.[41]

It stands to reason that this noncooperative equilibrium is inefficient, as there are always gains from trade. Less clear, however, is which tariff combinations are efficient. This is the subject of the second proposition:

Proposition 2 *The set of Pareto-efficient tariff combinations consists of all* (τ,τ^*) *such that* $(\tau,\tau^*) = (\text{any possible } \tau, 0)$ *or* $(\tau,\tau^*) = (0, \text{ any possible } \tau^*)$

Proof. A tariff combination (τ,τ^*) cannot be Pareto efficient if there exist possible Pareto improving tariff changes $(d\tau, d\tau^*)$ at (τ,τ^*). This includes tariff changes $(d\tau, d\tau^*)$ such that $dG^* < 0$ and $dG = 0$. From total differentiation, $dG = \frac{\partial G}{\partial \tau}d\tau + \frac{\partial G}{\partial \tau^*}d\tau^*$ and $dG^* = \frac{\partial G^*}{\partial \tau}d\tau + \frac{\partial G^*}{\partial \tau^*}d\tau^*$. Therefore, $dG = 0$ if $d\tau = -\frac{\partial \tau}{\partial G}\frac{\partial G}{\partial \tau^*}d\tau^*$ so that $dG^* = \left(\frac{\partial G^*}{\partial \tau^*} - \frac{\partial G^*}{\partial \tau}\frac{\partial \tau}{\partial G}\frac{\partial G}{\partial \tau^*}\right)d\tau^*$ along $dG = 0$. Notice that $\frac{\partial G^*}{\partial \tau^*} - \frac{\partial G^*}{\partial \tau}\frac{\partial \tau}{\partial G}\frac{\partial G}{\partial \tau^*} > 0$ if $\tau^* \in [0,\infty)$ and that $\frac{\partial G^*}{\partial \tau^*} - \frac{\partial G^*}{\partial \tau}\frac{\partial \tau}{\partial G}\frac{\partial G}{\partial \tau^*} = 0$ if $\tau^* = \infty$. This is because $\frac{\partial G}{\partial \tau} = -\frac{(\phi\phi^*)^{-\sigma}\phi^*}{1-(\phi\phi^*)^{1-\sigma}}G$, $\frac{\partial G}{\partial \tau^*} = \frac{(1-\phi^{1-\sigma})\phi^{*-\sigma}}{(1-\phi^{*1-\sigma})[1-(\phi\phi^*)^{1-\sigma}]}G$, $\frac{\partial G^*}{\partial \tau} = \frac{(1-\phi^{*1-\sigma})\phi^{-\sigma}}{(1-\phi^{1-\sigma})[1-(\phi\phi^*)^{1-\sigma}]}G^*$, and $\frac{\partial G^*}{\partial \tau^*} = -\frac{(\phi\phi^*)^{-\sigma}\phi}{1-(\phi\phi^*)^{1-\sigma}}G^*$ so that $\frac{\partial G^*}{\partial \tau^*} - \frac{\partial G^*}{\partial \tau}\frac{\partial \tau}{\partial G}\frac{\partial G}{\partial \tau^*} = \frac{G^*}{\phi^*}$. Hence, there exist Pareto improving tariff changes $(d\tau, d\tau^*)$ for all (τ,τ^*), $\tau^* \neq \infty$. These $(d\tau, d\tau^*)$ are such that $d\tau < 0$ and $d\tau^* < 0$ and are thus possible if and only if $\tau > 0$ and $\tau^* > 0$. If $\tau^* = \infty$, $\frac{\partial G}{\partial \tau} = \frac{\partial G}{\partial \tau^*} = \frac{\partial G^*}{\partial \tau^*} = 0$ and

[41] Essentially, the Lerner symmetry theorem is reversed in this environment. Export taxes imposed by Home are now equivalent to import tariffs imposed by *Foreign* rather than *Home.*

$\frac{\partial G^*}{\partial \tau} > 0$ unless also $\tau = \infty$. Hence, there also exist Pareto improving tariff changes $(d\tau, d\tau^*)$ for all (τ, τ^*), $\tau \neq \infty, \tau^* = \infty$. These $(d\tau, d\tau^*)$ are such that $d\tau < 0$ and are thus possible if and only if $\tau > 0$. Finally, it is straightforward to verify that $(\tau, \tau^*) = (\infty, \infty)$ is also not Pareto efficient since there exist possible Pareto improving tariff changes $(\Delta\, \tau, \Delta\, \tau^*)$ (e.g. complete trade liberalization). Therefore, only (τ, τ^*) such that $(\tau, \tau^*) =$ (any possible $\tau, 0$) or $(\tau, \tau^*) = (0,$ any possible $\tau^*)$ can be Pareto efficient. It is easy to verify that for none of these (τ, τ^*) there exists another (τ, τ^*) which makes one country better off without making the other country worse off. Therefore, they are also indeed Pareto efficient. ∎

Corollary 1 *The trade war equilibrium tariffs* $(\tau, \tau^*) = (\infty, \infty)$ *are inefficient*

Intuitively, Pareto improvements can only be achieved through bilateral tariff reductions. This is because a unilateral tariff cut reduces the welfare of the liberalizing country, due to the 'Venables Effect'. However, bilateral tariff reductions are only possible if tariffs are positive in both countries so that Pareto improvements cannot be achieved if the tariff is zero in at least one of the countries.

Corollary 1 implies that there is scope for trade negotiations, since both countries can gain from a tariff reduction. Nash bargaining would be one simple way of modelling such trade negotiations.[42] However, this would not adequately capture the 'rules-based' nature of GATT/WTO negotiations and

[42]This route has been pursued in the earlier contributions to the Neoclassical theory of trade negotiations. See Dixit (1987) for a review. In the context of the model discussed here, it is easy to show that the Nash bargaining solution is free trade, if one allows for side payments. This is because free trade maximizes world welfare.

would hence be ill-suited to shed light on the roles played by the principles of reciprocity and nondiscrimination.[43] Instead, I proceed with the following observation:

Proposition 3 *Define a tariff change* $(\triangle\,\tau, \triangle\,\tau^*)$ *to be reciprocal if it is such that* $\triangle\, TB_M = 0$, *where* $TB_M \equiv EXP_M - IMP_M$ *and* EXP_M (IMP_M) *refers to the value of manufacturing exports (imports).*[44] *Then, starting from any tariff combination* (τ, τ^*), *tariff changes leave the number of firms unchanged in both countries if and only if they are reciprocal*

Proof. By definition, $TB_M = \mu L p^{1-\sigma}\left(n\phi^{*1-\sigma}G^{*\sigma-1} - n^*\phi^{1-\sigma}G^{\sigma-1}\right)$ so that $\frac{TB_M}{\mu L} = \frac{n\phi^{*1-\sigma}}{n\phi^{*1-\sigma}+n^*} - \frac{n^*\phi^{1-\sigma}}{n+n^*\phi^{1-\sigma}}$. Also, $\frac{nqp}{\mu L} = \frac{n}{n+n^*\phi^{1-\sigma}} + \frac{n\phi^{*1-\sigma}}{n\phi^{*1-\sigma}+n^*}$ from Home's manufacturing market clearing condition. Hence, $n = \frac{\mu L}{qp} + \frac{TB_M}{qp}$ which implies that $\triangle\, n = 0$ if and only if $\triangle\, TB_M = 0$. Finally, since $n + n^* = 2\frac{\mu L}{qp}$, $\triangle\, n = 0$ if and only if $\triangle\, n^* = 0$ ■

Thus, if tariff changes are restricted to be reciprocal, both countries are no longer able to attract firms from the other country. To gain a better understanding of this observation, it is useful to consider in more detail the key equation of the above proof:

$$n = \frac{\mu L}{qp} + \frac{TB_M}{qp} \tag{77}$$

It states that the number of manufacturing firms at Home consists of the number of manufacturing firms Home would have under autarky plus the ad-

[43]See Bagwell and Staiger (1999) and especially Bagwell and Staiger (2002) for a more detailed discussion of why GATT/WTO negotiations are not well-characterized by Nash bargaining.

[44]Notice that $TB^*_M = -TB_M$ so that also $\triangle\, TB^*_M = 0$ if tariff changes are reciprocal.

ditional number of firms required to satisfy the net demand from Foreign. To see this, notice that μL is Home's expenditure on manufacturing goods, TB_M is Foreign's net expenditure on Home's manufacturing goods, and qp is the (constant) level of firm sales. Hence, if Foreign's net expenditure on Home's manufacturing goods is fixed by reciprocity, Home's (and hence also Foreign's) number of manufacturing firms is fixed as well.

Since inefficiently high tariffs arise only because both countries attempt to attract firms from the other country, this observation suggests that the principle of reciprocity can help countries achieve an efficient outcome by neutralizing the 'Venables Effect'. To see that this is indeed the case, consider the following tariff setting game which, I believe, captures some of the essential features of GATT/WTO negotiations:

Proposition 4 *Suppose tariffs are set in the following three-stage game: in the first stage, governments choose tariffs cooperatively according to some bargaining protocol. In the second stage, Home has the opportunity to deviate from the cooperative tariff by choosing any possible tariff to which Foreign can respond reciprocally.*[45] *In the third stage, Foreign responds reciprocally to Home's deviation.*[46] *Then, Home does not deviate in the second stage if and only if efficient tariffs are chosen in the first stage. Moreover, if inefficient tariffs are chosen in the first stage, Home's deviation is such that tariffs are efficient after the third stage*

[45] This assumption is only made to simplify the exposition. It is easy to verify that H would anyway never find it optimal to choose a tariff to which F cannot respond reciprocally.

[46] Similar to Bagwell and Staiger (1999), I hence assume that the GATT/WTO can perfectly enforce the principle of reciprocity (and later also the principle of nondiscrimination). See Maggi (1999) for a model of multilateral trade agreements that puts enforcement issues at centre stage.

Proof. Suppose that the governments have agreed on some arbitrary tariffs in the first stage and consider Home's incentives to choose any other tariff to which Foreign can respond reciprocally given that Foreign then indeed responds reciprocally. Notice that $\frac{dG}{d\tau} > 0$ at all (τ, τ^*) if $d\tau$ is followed by a reciprocal $d\tau^*$. This is because reciprocal tariff changes leave the number of firms unchanged (from proposition 3) and $G = p\left[n + n^*\phi^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$. Therefore, Home has an incentive to reduce τ at any (τ, τ^*). However, a reduction in τ is possible if and only if $\tau > 0$. Moreover, a reciprocal response to a reduction in τ is possible if and only if $\tau^* > 0$. This is because $(d\tau, d\tau^*)$ is reciprocal if and only if it is such that $\frac{\phi^{-\sigma}}{(G^{1-\sigma})^2}d\tau = \frac{\phi^{*-\sigma}}{(G^{*1-\sigma})^2}d\tau^*$, from Home's manufacturing market clearing condition. Hence, Home does not deviate in the second stage if and only if $\tau = 0$ and/or $\tau^* = 0$. Moreover, if $\tau > 0$ and $\tau^* > 0$, the deviation is such that $\tau = 0$ and/or $\tau^* = 0$ after the third stage. These tariff combinations are efficient (from proposition 2). ■

The intuition for this finding is as follows: in this model, imposing a tariff has two effects on welfare. First, it tends to increase the domestic price index by making imported manufacturing goods more expensive. Second, it tends to reduce the domestic price index by attracting manufacturing firms from abroad. Normally, the latter effect dominates the former so that countries have an incentive to impose a tariff. However, the latter effect is neutralized by reciprocity so that then only the former effect remains. When given the opportunity to deviate, Home therefore has an incentive to lower its tariff by as much as possible so that either Home's or Foreign's tariff is eventually reduced to zero.

4.3 Three-country extension

4.3.1 Setup

While the basic two-country model is useful to illustrate the purpose of trade negotiations and the role played by the principle of reciprocity, it is too simple to shed light on the role played by the principle of nondiscrimination. For this reason, I develop an extension of the basic model in this section. In particular, I focus on the simplest possible setup that allows for discriminatory tariff setting. There are now three countries: Home, Foreign 1, and Foreign 2. Home trades with both Foreign 1 and Foreign 2, but Foreign 1 and Foreign 2 trade with Home only so that only Home can set discriminatory tariffs. Everything else is just as in the basic model.[47] The notation is a straightforward generalization of the one used before. For example, τ_1 is now the tariff imposed by Home against imports from Foreign 1, τ_2^* is now the tariff imposed by Foreign 2 against imports from Home, and G_1^* is the manufacturing price index of Foreign 1.

4.3.2 No trade policy

The derivation of the equilibrium proceeds exactly as before and is thus not repeated here in detail. Instead, I focus only on its key steps and present only the model's key relationships. As before, all firms charge the same price in

[47] One further difference is as follows: For simplicity, I again assume that the outside good sector is active in all countries and that the manufacturing sector is always active in all countries. However, this now requires tighter parameter restrictions: $\mu < \frac{1}{3}$ and $\theta > \left(\frac{1}{3}\right)^{\frac{1}{1-\sigma}}$, respectively. Details can again be found in appendix A1.

equilibrium and the price indices can be written as

$$G = p\left[n + n_1^*\phi_1^{1-\sigma} + n_2^*\phi_2^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \tag{78}$$

$$G_1^* = p\left[n\phi_1^{*1-\sigma} + n_1^*\right]^{\frac{1}{1-\sigma}} \tag{79}$$

$$G_2^* = p\left[n\phi_2^{*1-\sigma} + n_2^*\right]^{\frac{1}{1-\sigma}} \tag{80}$$

Manufacturing market clearing requires

$$q = \mu L\frac{p^{-\sigma}}{G^{1-\sigma}} + \mu L\phi_1^{*1-\sigma}\frac{p^{-\sigma}}{G_1^{*1-\sigma}} + \mu L\phi_2^{*1-\sigma}\frac{p^{-\sigma}}{G_2^{*1-\sigma}} \tag{81}$$

$$q = \mu L\phi_1^{1-\sigma}\frac{p^{-\sigma}}{G^{1-\sigma}} + \mu L\frac{p^{-\sigma}}{G_1^{*1-\sigma}} \tag{82}$$

$$q = \mu L\phi_2^{1-\sigma}\frac{p^{-\sigma}}{G^{1-\sigma}} + \mu L\frac{p^{-\sigma}}{G_2^{*1-\sigma}} \tag{83}$$

where the equations refer to Home, Foreign 1, and Foreign 2, respectively. These equations can be solved for the equilibrium price indices. Defining

$$\Phi \equiv 1 - \phi_1^{*1-\sigma} - \phi_2^{*1-\sigma} \tag{84}$$

$$\Phi_1 \equiv 1 - \phi_1^{1-\sigma} - \phi_2^{*1-\sigma}\left(\phi_2^{1-\sigma} - \phi_1^{1-\sigma}\right) \tag{85}$$

$$\Phi_2 \equiv 1 - \phi_2^{1-\sigma} - \phi_1^{*1-\sigma}\left(\phi_1^{1-\sigma} - \phi_2^{1-\sigma}\right) \tag{86}$$

$$\Omega \equiv 1 - (\phi_1\phi_1^*)^{1-\sigma} - (\phi_2\phi_2^*)^{1-\sigma} \tag{87}$$

they can be written as

$$G = \left[\frac{qp^{\sigma}\Phi}{\mu L\Omega}\right]^{\frac{1}{\sigma-1}} \tag{88}$$

$$G_1^* = \left[\frac{qp^\sigma \Phi_1}{\mu L \Omega}\right]^{\frac{1}{\sigma-1}} \tag{89}$$

$$G_2^* = \left[\frac{qp^\sigma \Phi_2}{\mu L \Omega}\right]^{\frac{1}{\sigma-1}} \tag{90}$$

These price indices can then be solved for the equilibrium number of firms

$$n = \frac{\mu L}{qp}\left[\frac{1}{\Phi} - \frac{\phi_1^{1-\sigma}}{\Phi_1} - \frac{\phi_2^{1-\sigma}}{\Phi_2}\right] \tag{91}$$

$$n_1^* = \frac{\mu L}{qp}\left[\frac{1-(\phi_2\phi_2^*)^{1-\sigma}}{\Phi_1} + \frac{(\phi_1^*\phi_2)^{1-\sigma}}{\Phi_2} - \frac{\phi_1^{*1-\sigma}}{\Phi}\right] \tag{92}$$

$$n_2^* = \frac{\mu L}{qp}\left[\frac{1-(\phi_1\phi_1^*)^{1-\sigma}}{\Phi_2} + \frac{(\phi_1\phi_2^*)^{1-\sigma}}{\Phi_1} - \frac{\phi_2^{*1-\sigma}}{\Phi}\right] \tag{93}$$

These expressions again imply that the world number of manufacturing firms is constant. Since there are now three countries, it is given by

$$n + n_1^* + n_2^* = 3\frac{\mu L}{qp} \tag{94}$$

4.3.3 Trade policy

The following four propositions are generalizations of propositions 1-4. They establish that the basic model's main results carry over to the three-country model. The intuitions for these propositions are analogous to the intuitions given above for propositions 1-4 and are thus not repeated here. First, the trade-war equilibrium is autarky:

Proposition 5 *Suppose governments choose tariffs simultaneously, Home maximizing V, Foreign 1 maximizing V_1^*, and Foreign 2 maximizing V_2^*. Then the only Nash equilibrium tariff combination which is robust to small per-*

turbations in the governments' strategies (i.e. 'trembling-hand perfect') is $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (\infty, \infty, \infty, \infty)$

Proof. The proof is a generalization of the proof of proposition 1. It can be found in appendix A2 ∎

Second, the Pareto efficient tariff combinations are such that at least one tariff is zero in each of the two bilateral trading relationships. This implies that the trade-war equilibrium tariffs are inefficient:

Proposition 6 *The set of Pareto-efficient tariff combinations consists of all* $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ *such that (i)* $(\tau_1, \tau_1^*) = $ *(any possible* $\tau_1, 0)$ *or* $(\tau_1, \tau_1^*) = (0,$ *any possible* $\tau_1^*)$ *and (ii)* $(\tau_2, \tau_2^*) = $ *(any possible* $\tau_2, 0)$ *or* $(\tau_2, \tau_2^*) = (0,$ *any possible* $\tau_2^*)$

Proof. The proof is a generalization of the proof of proposition 2. It can be found in appendix A3 ∎

Corollary 2 *The trade war equilibrium tariffs* $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (\infty, \infty, \infty, \infty)$ *are inefficient*

Third, no country is able to attract firms from another country if tariff changes keep all countries' manufacturing trade balances unchanged:

Proposition 7 *Define a tariff change* $(\triangle\, \tau_1, \triangle\, \tau_2, \triangle\, \tau_1^*, \triangle\, \tau_2^*)$ *to be multilaterally reciprocal if it is such that* $\triangle\, TB_{M1}^* = \triangle\, TB_{M2}^* = 0$*, where* $TB_{Mi}^* \equiv EXP_{Mi}^* - IMP_{Mi}^*$ *and* EXP_{Mi}^* (IMP_{Mi}^*) *refers to the value of manufacturing exports (imports) in country Foreign i.*[48] *Then, starting from any tariff*

[48] Notice that $TB_M = -(TB_{M1}^* + TB_{M2}^*)$ so that also $\triangle\, TB_M = 0$ if tariff changes are multilaterally reciprocal.

vector $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$, *tariff changes leave the number of firms unchanged in all countries if and only if they are multilaterally reciprocal*

Proof. The proof is a generalization of the proof of proposition 3. It can be found in appendix A4 ■

And fourth, if tariff changes are restricted to keep all countries' manufacturing trade balances unchanged, this can help governments achieve an efficient outcome:

Proposition 8 *Suppose tariffs are set in the following three-stage game: in the first stage, governments choose tariffs cooperatively according to some bargaining protocol. In the second stage, Home has the opportunity to deviate from the cooperative tariffs by choosing any possible tariffs to which Foreign 1 and Foreign 2 can respond in a multilaterally reciprocal fashion. In the third stage, Foreign 1 and Foreign 2 respond in a multilaterally reciprocal fashion. Then, Home does not deviate in the second stage if and only if efficient tariffs are chosen in the first stage. Moreover, if inefficient tariffs are chosen in the first stage, Home's deviation is such that tariffs are efficient after the third stage*

Proof. The proof is a generalization of the proof of proposition 4. It can be found in appendix A5 ■

However, propositions 7 and 8 depend crucially on the fact that *multilateral* reciprocity is imposed. If instead, only *bilateral* reciprocity is imposed, firm relocations are not necessarily prevented. This is made more precise in the following proposition:

Proposition 9 *Define a tariff change* $(\triangle\, \tau_i, \triangle\, \tau_i^*)$ *to be bilaterally reciprocal if it is such that* $\triangle\, TB_{Mi}^* = 0$*, where* $TB_{Mi}^* \equiv EXP_{Mi}^* - IMP_{Mi}^*$ *and* EXP_{Mi}^* (IMP_{Mi}^*) *refers to the value of manufacturing exports (imports) in country Foreign i. Then, starting from any tariff combination* $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$*, a bilaterally reciprocal tariff change between Home and Foreign i keeps the number of firms constant in Foreign i but changes the number of firms in Home and Foreign j*

Proof. Consider a bilaterally reciprocal tariff change $(d\tau_i, d\tau_i^*)$ between Home and Foreign i. By definition, it leaves TB_{Mi}^* unchanged so that n_i^* is also unchanged (c.f. the proof of proposition 7). However, it also leaves n and n_j^* unchanged if and only if it is also multilaterally reciprocal (from proposition 7). This requires $\frac{(n+n_j^*\phi_j^{1-\sigma})\phi_i^{-\sigma}}{(G^{1-\sigma})^2} d\tau_i = \frac{n\phi_i^{*-\sigma}}{(G_i^{*1-\sigma})^2} d\tau_i^*$ and $\frac{n_i^*\phi_j^{1-\sigma}\phi_i^{-\sigma}}{(G^{1-\sigma})^2} d\tau_i = 0$, from manufacturing market clearing at Foreign i and Foreign j. But this implies $d\tau_i = d\tau_i^* = 0$ so that n and n_j^* must change for any (nonzero) tariff change ■

Thus, while bilaterally reciprocal tariff changes prevent firm relocations between the tariff-changing country pair, they always also induce firm relocations from or to the uninvolved country. This is because the uninvolved country is also affected by the tariff change through changes in Home's price index. To see this more clearly, suppose that Home and Foreign 1 liberalize in a bilaterally reciprocal way. From the above discussion it should be obvious that this prevents firm relocations between Home and Foreign 1. However, it also reduces Home's price index and thus reduces sales and profits of firms in Foreign 2 which requires firm relocations between Home and Foreign 2 to restore equilibrium.

If the objective is to prevent firm relocations between all countries, the principle of reciprocity is therefore insufficient to the extent that it can be applied bilaterally. In view of this, the principle of nondiscrimination can then be interpreted as a simple way to 'multilateralize' the principle of reciprocity. To see this, consider the following proposition:

Proposition 10 *Define tariffs to be nondiscriminatory if* $\tau_1 = \tau_2 \equiv \tau$. *Then, if tariffs are restricted to be nondiscriminatory, all bilaterally reciprocal tariff changes are also multilaterally reciprocal*

Proof. If tariffs are restricted to be nondiscriminatory, $d\tau_1 = d\tau_2$ so that purely bilateral tariff changes between Home and Foreign 1 or Home and Foreign 2 are not possible. Hence, if tariff changes are nondiscriminatory and bilaterally reciprocal they must be bilaterally reciprocal between Home and Foreign 1 and Home and Foreign 2. Since tariff changes which are bilaterally reciprocal between Home and Foreign 1 and Home and Foreign 2 are also multilaterally reciprocal this implies that all tariff changes which are nondiscriminatory and bilaterally reciprocal must also be multilaterally reciprocal

■

The reasoning for this is very simple: if Home is forced to impose the same tariff against Foreign 1 and Foreign 2, and both Foreign 1 and Foreign 2 respond to tariff changes by Home in a bilaterally reciprocal way, both trade balances are kept constant so that multilateral reciprocity prevails.

Hence, all firm relocations are prevented if tariff changes are bilaterally reciprocal and nondiscriminatory so that these principles together can help countries move towards a more efficient outcome. However, the principle of nondiscrimination is an overly restrictive way of 'multilateralizing' the principle of reciprocity which implies that the final outcome can, but need not, be efficient. This result is established in the final proposition:

Proposition 11 *Suppose tariffs are set in the following three-stage game: in all stages, Home is restricted to set nondiscriminatory tariffs only. In the first stage, governments choose tariffs cooperatively according to some bargaining protocol. In the second stage, Home has the opportunity to deviate from the cooperative tariffs by choosing any possible tariffs to which Foreign 1 and Foreign 2 can both respond in a bilaterally reciprocal fashion. In the third stage, Foreign 1 and Foreign 2 both respond in a bilaterally reciprocal fashion. Then, Home does not deviate in the second stage if efficient tariffs are chosen in the first stage. However, Home also does not deviate in the second stage if particular inefficient tariffs are chosen in the first stage so that tariffs are not necessarily efficient after the third stage*

Proof. Suppose that the governments have agreed on some arbitrary nondiscriminatory tariffs in the first stage and consider Home's incentives to choose any other nondiscriminatory tariffs to which Foreign 1 and Foreign 2 can both respond in a bilaterally reciprocal fashion given that Foreign 1 and Foreign 2 then indeed both respond in a bilaterally reciprocal fashion. Notice that $\frac{dG}{d\tau} < 0$ at all $(\tau, \tau_1^*, \tau_2^*)$ if $d\tau$ is followed by bilaterally reciprocal $d\tau_1^*$ and $d\tau_2^*$. This is because with nondiscrimination all bilaterally reciprocal tariff changes leave the number of firms unchanged in all countries (from propositions 7 and 9) and $G = p\left[n + \phi^{1-\sigma}\left(n_1^* + n_2^*\right)\right]^{\frac{1}{1-\sigma}}$. Therefore, Home has an incentive to reduce τ at any $(\tau, \tau_1^*, \tau_2^*)$. However, a reduction in τ is possible if and only if

$\tau > 0$. Moreover, a bilaterally reciprocal response to a reduction in τ is possible if and only if $\tau_1^* > 0$ and $\tau_2^* > 0$. This is because $(d\tau, d\tau_1^*, d\tau_2^*)$ is bilaterally reciprocal if and only if it is such that $\frac{\phi^{-\sigma}}{(G^{1-\sigma})^2} d\tau = \frac{\phi_1^{*-\sigma}}{(G_1^{*1-\sigma})^2} d\tau_1^* = \frac{\phi_2^{*-\sigma}}{(G_2^{*1-\sigma})^2} d\tau_2^*$, from Foreign 1's and Foreign 2's manufacturing market clearing conditions. Hence, Home does not deviate in the second stage if and only if $\tau = 0$ and/or $\tau_1^* = 0$ and/or $\tau_2^* = 0$. This is includes all efficient tariff combinations which are possible under nondiscrimination, i.e. $\tau = 0$ and/or $\tau_1^* = 0$ and $\tau_2^* = 0$. But it also includes two kinds of inefficient tariff combinations, first $\tau > 0$ and $\tau_1^* > 0$ and $\tau_2^* = 0$, and second $\tau > 0$ and $\tau_1^* = 0$ and $\tau_2^* > 0$ ■

As before, Home has an incentive to reduce its tariffs by as much as possible when given the opportunity to deviate. However, bilateral reciprocity and nondiscrimination can only be satisfied if all tariffs are lowered simultaneously. But this is impossible if at least one of the tariffs is equal to zero which is not sufficient to guarantee efficiency, from proposition 6.

4.4 Conclusion

In this chapter, I developed a 'new trade' theory of GATT/WTO negotiations. I first argued that tariffs are inefficiently high in the non-cooperative equilibrium because countries attempt to improve their relative market access at the expense of other countries in order to attract manufacturing firms from abroad. I then showed how GATT/WTO negotiations can help countries overcome this inefficiency by providing new rationales for the fundamental GATT/WTO principles of reciprocity and nondiscrimination.

This 'new trade' theory solves two important problems of the standard terms-of-trade theory. First, it is consistent with the fact that GATT/WTO regulations do not constrain export taxes. Second, it does not rely on the terms-of-trade argument but instead emphasizes market access considerations.

Still, much further work is needed. To fully develop this 'new trade' theory of trade negotiations, three questions seem to be particularly important: first, do preferential trading agreements as permitted under GATT/WTO regulations in violation of the principle of nondiscrimination undermine multilateral trade negotiations? Second, what is the role of political economy considerations in multilateral trade negotiations? And third, how does the GATT/WTO enforce the rules of reciprocity and nondiscrimination?[49]

[49] See Bagwell and Staiger (2002) for a discussion of how these questions are addressed in the context of the standard terms-of-trade theory.

4.5 Appendix

4.5.1 A1: Parameter restrictions

Two-country model

1. The outside good sector is always active in both countries if and only if both countries are large enough to host the total number of world manufacturing firms. This implies that $(n + n^*)\, l < L \iff \frac{\mu l}{qp} < \frac{1}{2} \iff \mu < \frac{1}{2}$.

2. Suppose there are no manufacturing firms in country i and consider the incentives to enter. It is straightforward to show that, at price p, at least $\frac{\mu L}{p\theta^{1-\sigma}(n+n^*)}$ units could be sold given any (τ, τ^*). Hence, entry is always profitable if and only if $\frac{\mu L}{p\theta^{1-\sigma}(n+n^*)} > q \iff \theta^{1-\sigma} < \frac{1}{2}$.

Three-country model

1. The outside good sector is always active in all countries if and only if all countries are large enough to host the total number of world manufacturing firms. This implies that $(n + n_1^* + n_2^*)\, l < L \iff \frac{\mu l}{qp} < \frac{1}{3} \iff \mu < \frac{1}{3}$.

2. Suppose there are no manufacturing firms in country i and consider the incentives to enter. It is straightforward to show that, at price p, at least $\frac{\mu L}{p\theta^{1-\sigma}\left(n+n_1^*+n_2^*\right)}$ units could be sold given any $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$. Hence, entry is always profitable if and only if $\frac{\mu L}{p\theta^{1-\sigma}\left(n+n_1^*+n_2^*\right)} > q \iff \theta^{1-\sigma} < \frac{1}{3}$.

4.5.2 A2: Proof of proposition 5

Proof. $\frac{\partial G}{\partial \tau_i} = -\frac{(\phi_i \phi_i^*)^{-\sigma} \phi_i^*}{\Omega} G$ so that $\frac{\partial G}{\partial \tau_i} < 0$ for all $\tau_i^* \in [0, \infty)$ and $\frac{\partial G}{\partial \tau_i} = 0$

for $\tau_i^* = \infty$. Hence, H maximizes V by choosing $\tau_i = \infty$ if $\tau_i^* \in [0, \infty)$ and any possible τ_i if $\tau_i^* = \infty$. Similarly, $\frac{\partial G_i^*}{\partial \tau_i^*} = -\frac{(\phi_i \phi_i^*)^{-\sigma} \phi_i}{\Omega} G_i^*$ so that $\frac{\partial G_i^*}{\partial \tau_i^*} < 0$ for all $\tau_i \in [0, \infty)$ and $\frac{\partial G_i^*}{\partial \tau_i^*} = 0$ for $\tau_i = \infty$. Hence, Foreign i maximizes V_i^* by choosing $\tau_i^* = \infty$ if $\tau_i \in [0, \infty)$ and any possible τ_i^* if $\tau_i = \infty$. Thus, the set of Nash equilibrium tariffs consists of all $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ such that either $(\tau_1, \tau_1^*) = (\infty,$ any possible $\tau_1^*)$ or $(\tau_1, \tau_1^*) =$ (any possible τ_1, $\infty)$ and either $(\tau_2, \tau_2^*) = (\infty,$ any possible $\tau_2^*)$ or $(\tau_2, \tau_2^*) =$ (any possible τ_2, $\infty)$. However, if the governments' strategies are subject to small perturbations, H's (Foreign i's) best response is always to choose $\tau_i = \infty$ $(\tau_i^* = \infty)$. Therefore, $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (\infty, \infty, \infty, \infty)$ is the only Nash equilibrium tariff combination which is robust to small perturbations in the governments' strategies ('trembling-hand perfect') ■

4.5.3 A3: Proof of proposition 6

Proof. A tariff combination $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ cannot be Pareto efficient if there exist possible Pareto improving tariff changes $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$ at $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$. This includes tariff changes $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$, $d\tau_2 = d\tau_2^* = 0$, such that $dG_1^* < 0$ and $dG = dG_2^* = 0$. From total differentiation, $dG = \frac{\partial G}{\partial \tau_1} d\tau_1 + \frac{\partial G}{\partial \tau_1^*} d\tau_1^*$, $dG_1^* = \frac{\partial G_1^*}{\partial \tau_1} d\tau_1 + \frac{\partial G_1^*}{\partial \tau_1^*} d\tau_1^*$, and $dG_2^* = \frac{\partial G_2^*}{\partial \tau_1} d\tau_1 + \frac{\partial G_2^*}{\partial \tau_1^*} d\tau_1^*$. Therefore, $dG = 0$ if $d\tau_1 = -\frac{\partial \tau_1}{\partial G} \frac{\partial G}{\partial \tau_1^*} d\tau_1^*$ and $dG_2^* = 0$ if $d\tau_1 = -\frac{\partial \tau_1}{\partial G_2^*} \frac{\partial G_2^*}{\partial \tau_1^*} d\tau_1^*$. Notice that these two conditions are identical. This is because $\frac{\partial G}{\partial \tau_1} = -\frac{(\phi_1 \phi_1^*)^{-\sigma} \phi_1^*}{\Omega} G$, $\frac{\partial G}{\partial \tau_1^*} = \frac{\Phi_1 \phi_1^{*-\sigma}}{\Omega \Phi} G$, $\frac{\partial G_2^*}{\partial \tau_1} = \frac{\Phi (\phi_1 \phi_1^*)^{-\sigma} \phi_1^* \phi_2^{1-\sigma}}{\Omega \Phi_2} G_2^*$, and $\frac{\partial G_2^*}{\partial \tau_1^*} = -\frac{\Phi_1 \phi_1^{*-\sigma} \phi_2^{1-\sigma}}{\Omega \Phi_2} G_2^*$ so that $-\frac{\partial \tau_1}{\partial G} \frac{\partial G}{\partial \tau_1^*} = -\frac{\partial \tau_1}{\partial G_2^*} \frac{\partial G_2^*}{\partial \tau_1^*}$. Hence, along $dG = dG_2^* = 0$, $dG_1^* = \left(\frac{\partial G_1^*}{\partial \tau_1^*} - \frac{\partial G_1^*}{\partial \tau_1} \frac{\partial \tau_1}{\partial G} \frac{\partial G}{\partial \tau_1^*} \right) d\tau_1^*$. Notice that $\frac{\partial G_1^*}{\partial \tau_1^*} - \frac{\partial G_1^*}{\partial \tau_1} \frac{\partial \tau_1}{\partial G} \frac{\partial G}{\partial \tau_1^*} > 0$ if $\tau_1^* \in [0, \infty)$ and that $\frac{\partial G_1^*}{\partial \tau_1^*} - \frac{\partial G_1^*}{\partial \tau_1} \frac{\partial \tau_1}{\partial G} \frac{\partial G}{\partial \tau_1^*} = 0$ if $\tau_1^* = \infty$. This is because $\frac{\partial G_1^*}{\partial \tau_1^*} = -\frac{(\phi_1 \phi_1^*)^{-\sigma} \phi_1}{\Omega} G_1^*$ which, together with the derivatives given above, implies that $\frac{\partial G_1^*}{\partial \tau_1^*} - \frac{\partial G_1^*}{\partial \tau_1}\frac{\partial \tau_1}{\partial G}\frac{\partial G}{\partial \tau_1^*} = \frac{G_1^*}{\phi_1^*}$. Hence, there exist Pareto improving tariff changes $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$, $d\tau_2 = d\tau_2^* = 0$, such that $dG_1^* < 0$ and $dG = dG_2^* = 0$ for all $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$, $\tau_1^* \neq \infty$. These $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$ are such that $d\tau_1 < 0$ and $d\tau_1^* < 0$ and are thus possible if and only if $\tau_1 > 0$ and $\tau_1^* > 0$. By symmetry, there also exist Pareto improving tariff changes $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$, $d\tau_1 = d\tau_1^* = 0$, such that $dG_2^* < 0$ and $dG = dG_1^* = 0$ for all $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$, $\tau_2^* \neq \infty$. These $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$ are such that $d\tau_2 < 0$ and $d\tau_2^* < 0$ and are thus possible if and only if $\tau_2 > 0$ and $\tau_2^* > 0$. If $\tau_1^* = \tau_2^* = \infty$, $\frac{\partial G}{\partial \tau_1} = \frac{\partial G}{\partial \tau_2} = \frac{\partial G}{\partial \tau_1^*} = \frac{\partial G}{\partial \tau_2^*} = \frac{\partial G_1^*}{\partial \tau_2} = \frac{\partial G_1^*}{\partial \tau_1^*} = \frac{\partial G_1^*}{\partial \tau_2^*} = \frac{\partial G_2^*}{\partial \tau_1} = \frac{G_2^*}{\partial \tau_1^*} = \frac{\partial G_2^*}{\partial \tau_2^*} = 0$ and $\frac{\partial G_1^*}{\partial \tau_1} > 0$ unless also $\tau_1 = \infty$ and $\frac{\partial G_2^*}{\partial \tau_2} > 0$ unless also $\tau_2 = \infty$. This follows from the derivatives given above, their symmetric counterparts, and $\frac{\partial G_1^*}{\partial \tau_1} = \frac{\Phi[1-(\phi_2\phi_2^*)^{1-\sigma}]\phi_1^{-\sigma}}{\Omega\Phi_1}G_1^*$, $\frac{\partial G_2^*}{\partial \tau_2} = \frac{\Phi[1-(\phi_1\phi_1^*)^{1-\sigma}]\phi_2^{-\sigma}}{\Omega\Phi_2}G_2^*$. Hence, there also exist Pareto improving tariff changes $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$ for all $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$, $\tau_1^* = \tau_2^* = \infty$ and $\tau_1 \neq \infty$ or $\tau_2 \neq \infty$. These tariff changes are possible if and only if $\tau_1 > 0$ and $\tau_2 > 0$. Finally, it is straightforward to verify that $\tau_1 = \tau_2 = \tau_1^* = \tau_2^* = \infty$ is also not Pareto efficient since there exist possible Pareto improving tariff changes $(\Delta\, \tau_1, \Delta\, \tau_2, \Delta\, \tau_1^*, \Delta\, \tau_2^*)$ (e.g. complete trade liberalization). Therefore, only $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ such that (i) (τ_1, τ_1^*) = (any possible τ_1, 0) or (τ_1, τ_1^*) = (0, any possible τ_1^*) and (ii) (τ_2, τ_2^*) = (any possible τ_2, 0) or (τ_2, τ_2^*) = (0, any possible τ_2^*) can be Pareto efficient. It is easy to verify that for none of these $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ there exists another $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ which makes one country better off without making at least one of the other countries worse off. Therefore, they are also indeed Pareto efficient ■

4.5.4 A4: Proof of proposition 7

Proof. By definition, $TB^*_{M1} = \mu L p^{1-\sigma}\left(n^*_1\phi_1^{1-\sigma}G^{\sigma-1} - n\phi_1^{*1-\sigma}G_1^{*\sigma-1}\right)$ so that $\frac{TB^*_{M1}}{\mu L} = \frac{n^*_1\phi_1^{1-\sigma}}{n+n^*_1\phi_1^{1-\sigma}+n^*_2\phi_2^{1-\sigma}} - \frac{n\phi_1^{*1-\sigma}}{n\phi_1^{*1-\sigma}+n^*_1}$. Also, $\frac{n^*_1 qp}{\mu L} = \frac{n^*_1\phi_1^{1-\sigma}}{n+n^*_1\phi_1^{1-\sigma}+n^*_2\phi_2^{1-\sigma}} + \frac{n^*_1}{n\phi_1^{*1-\sigma}+n^*_1}$ from manufacturing market clearing at Foreign 1. Hence, $n^*_1 = \frac{\mu L}{qp} + \frac{TB^*_{M1}}{qp}$ which implies that $\Delta\ n^*_1 = 0$ if and only if $\Delta\ TB^*_{M1} = 0$. By symmetry, also $n^*_2 = \frac{\mu L}{qp} + \frac{TB^*_{M2}}{qp}$ which implies that $\Delta\ n^*_2 = 0$ if and only if $\Delta\ TB^*_{M2} = 0$. Finally, since $n + n^*_1 + n^*_2 = 3\frac{\mu L}{qp}$, $\Delta\ n = 0$ if and only if $\Delta\ n^*_1 = \Delta\ n^*_2 = 0$ ■

4.5.5 A5: Proof of proposition 8

Proof. Suppose that the governments have agreed on some arbitrary tariffs in the first stage and consider H's incentives to choose any other tariffs to which Foreign 1 and Foreign 2 can respond in a multilaterally reciprocal fashion given that Foreign 1 and Foreign 2 then indeed respond in a multilaterally reciprocal fashion. Notice that $\frac{dG}{d(\tau_1,\tau_2)} > 0$ at all $(\tau_1, \tau_2, \tau^*_1, \tau^*_2)$ if $(d\tau_1, d\tau_2)$ is followed by a multilaterally reciprocal $(d\tau^*_1, d\tau^*_2)$. This is because multilaterally reciprocal tariff changes leave the number of firms unchanged in all countries (from proposition 7) and $G = p\left[n + n^*_1\phi_1^{1-\sigma} + n^*_2\phi_2^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$. Therefore, H has an incentive to reduce τ_1 and τ_2 at any $(\tau_1, \tau_2, \tau^*_1, \tau^*_2)$. However, a reduction in τ_1 is possible if and only if $\tau_1 > 0$, and a reduction in τ_2 is possible if and only if $\tau_2 > 0$. Moreover, (i) a multilaterally reciprocal response to a reduction in τ_1 and τ_2 is possible unless $\tau^*_1 = \tau^*_2 = 0$; (ii) a multilaterally reciprocal response to a reduction in only τ_1 is possible unless $\tau^*_1 = 0$; and (iii) a multilaterally reciprocal response to a reduction in only τ_2 is possible unless $\tau^*_2 = 0$. This is because $(d\tau_1, d\tau_2, d\tau^*_1, d\tau^*_2)$ is multilaterally reciprocal if and only if it is such that $\frac{\phi_1^{-\sigma}}{G^{1-\sigma}} d\tau_1 = \frac{\left(n+\phi_1^{1-\sigma} n_1^*\right)\phi_1^{*-\sigma}}{p^{\sigma-1}\left(G_1^{*1-\sigma}\right)^2} d\tau_1^* + \frac{\phi_1^{1-\sigma} n_2^* \phi_2^{*-\sigma}}{p^{\sigma-1}\left(G_2^{*1-\sigma}\right)^2} d\tau_2^*$ and $\frac{\phi_2^{-\sigma}}{G^{1-\sigma}} d\tau_2 = \frac{\phi_2^{1-\sigma} n_1^* \phi_1^{*-\sigma}}{p^{\sigma-1}\left(G_1^{*1-\sigma}\right)^2} d\tau_1^* + \frac{\left(n+\phi_2^{1-\sigma} n_2^*\right)\phi_2^{*-\sigma}}{p^{\sigma-1}\left(G_2^{*1-\sigma}\right)^2} d\tau_2^*$, from Foreign 1's and Foreign 2's manufacturing market clearing conditions. In particular, (i) if $d\tau_1 < 0$ and $d\tau_2 < 0$ it must be that $d\tau_1^* < 0$ and/or $d\tau_2^* < 0$, as follows immediately from the above equations; (ii) if $d\tau_1 < 0$ and $d\tau_2 = 0$ it must be that $d\tau_1^* < 0$ and $d\tau_2^* > 0$ since then $\frac{\phi_1^{*-\sigma}}{\left(G_1^{*1-\sigma}\right)^2} d\tau_1^* = -\frac{\left(n+\phi_2^{1-\sigma} n_2^*\right)\phi_2^{*-\sigma}}{\left(G_2^{*1-\sigma}\right)^2 \phi_2^{1-\sigma} n_1^*} d\tau_2^*$ and $\frac{\phi_1^{-\sigma}}{\left(G^{1-\sigma}\right)^2 n} d\tau_1 = -\frac{\phi_2^{*-\sigma}}{\left(G_2^{*1-\sigma}\right)^2 \phi_2^{1-\sigma} n_1^*} d\tau_2^*$; (iii) if $d\tau_1 = 0$ and $d\tau_2 < 0$ it must be that $d\tau_1^* > 0$ and $d\tau_2^* < 0$ since then $\frac{\phi_2^{*-\sigma}}{\left(G_2^{*1-\sigma}\right)^2} d\tau_2^* = -\frac{\left(n+\phi_1^{1-\sigma} n_1^*\right)\phi_1^{*-\sigma}}{\left(G_1^{*1-\sigma}\right)^2 \phi_1^{1-\sigma} n_2^*} d\tau_1^*$ and $\frac{\phi_2^{-\sigma}}{\left(G^{1-\sigma}\right)^2 n} d\tau_2 = -\frac{\phi_1^{*-\sigma}}{\left(G_1^{*1-\sigma}\right)^2 \phi_1^{1-\sigma} n_2^*} d\tau_1^*$. Hence, H does not deviate in the second stage if and only if $\tau_1 = \tau_2 = 0$ and/or $\tau_1^* = \tau_2^* = 0$ and/or $\tau_2 = \tau_1^* = 0$ and/or $\tau_1 = \tau_2^* = 0$. Moreover, the deviation is otherwise such that $\tau_1 = \tau_2 = 0$ and/or $\tau_1^* = \tau_2^* = 0$ and/or $\tau_2 = \tau_1^* = 0$ and/or $\tau_1 = \tau_2^* = 0$ after the third stage. These tariff combinations are efficient (from proposition 6) ■

5 Conclusion

In this thesis, I theoretically investigated three related aspects of international trade and economic development.

First, I presented a model of social learning about the suitability of local conditions for new business ventures and explored its implications for the microeconomic patterns of growth. The analysis delivered four main results. First, firms tend to invest in business ventures with which other firms have had surprising success, thus causing development to be 'lumpy'. One consequence of this 'lumpiness' is that improvements in the economic environment (policies, institutions, infrastructure, etc.) may map discontinuously into microeconomic growth. Second, sufficient business confidence is crucial for fostering economic growth and development. If firms have overly pessimistic initial beliefs, viable business ventures remain unattempted, whereas overly optimistic beliefs never make firms pursue non-viable ventures permanently. However, even if initial beliefs are sufficiently optimistic, viable ventures may be abandoned if firms misinterpret the evidence available to them. Third, development may involve a wave-like pattern of growth where successive business ventures are first pursued and then given up until a venture is found for which local conditions are sufficiently suitable. Finally, despite this potential 'stuttering' towards a viable venture, there is no guarantee that firms pursue the best venture even in the long-run.

Then, I developed a simple general equilibrium model of trade in which trade liberalization leads to outsourcing as firms focus on their core competencies in response to tougher competition. Since firms are better at performing tasks the closer they are to their core competencies, this outsourcing increases firm productivity. Besides establishing this result, I also investigated the links between various technological parameters and outsourcing. In particular, I analysed how technological progress, changes in fixed costs, and changes in internal governance costs affect firms' integration decisions.

Finally, I developed a 'new trade' theory of GATT/WTO negotiations. I first argued that tariffs are inefficiently high in the non-cooperative equilibrium because countries attempt to improve their relative market access at the expense of other countries in order to attract manufacturing firms from abroad. I then showed how GATT/WTO negotiations can help countries overcome this inefficiency by providing new rationales for the fundamental GATT/WTO principles of reciprocity and nondiscrimination. This 'new trade' theory solves two important problems of the standard terms-of-trade theory. First, it is consistent with the fact that GATT/WTO regulations do not constrain export taxes. Second, it does not rely on the terms-of-trade argument but instead emphasizes market access considerations.

References

[1] Aghion, P., Burgess, R., Redding, S., Zilibotti, F, 2005. Entry liberalization and inequality in industrial performance. Journal of the European Economic Association 3, 291-302.

[2] Arrieta, M., Abrego, G., Castillo, A., de la Fuente, M., 1990. Agricultura en Santa Cruz: De la economienda colonial a la empresa modernizada (1559 a 1985). Instituto Latinoamericano de Investigaciones Sociales, La Paz.

[3] Bagwell, K, Staiger, R.W., 1999. An economic theory of GATT. American Economic Review 89, 215-248.

[4] Bagwell, K, Staiger, R.W., 2002. The economics of the world trading system. The MIT Press, Cambridge.

[5] Bernard, A., Eaton, J., Jensen, J., Kortum, S., 2003. Plants and productivity in international trade. American Economic Review 93, 1268-1290.

[6] Bernard, A., Redding, S., Schott, P., 2006. Multi-product firms and trade liberalization. NBER working paper 12782.

[7] Burgess, R., Venables, A.J., 2004. Towards a microeconomics of growth, in: Bourguignon, F. , Pleskovic, B. (Eds.), Accelerating Development: Annual World Bank Conference on Development Economics, World Bank, Washington DC.

[8] Caplin, A., Leahy, J., 1993. Sectoral shocks, learning, and aggregate fluctuation. The Review of Economic Studies 30(4), 777–794.

[9] Caplin, A., Leahy, J., 1998. Miracle on Sixth Avenue: Information externalities and search. The Economic Journal 108, 60–74.

[10] Chamley, C.P., 2004. Rational herds. Economic models of social learning. Cambridge University Press, Cambridge.

[11] Clerides, S. K., Lach, S., Tybout, J.R., 1998. Is learning by exporting important? Micro-dynamic evidence from Columbia, Mexico, and Morocco. Quarterly Journal of Economics 113, 903-947.

[12] Dixit, A., Grossman, G. M., 1983. Trade and protection with multi-stage production. Review of Economic Studies 49, 583-594.

[13] Dixit, A., 1987. Strategic aspects of trade policy, in: Bewley, T.F. (Ed.), Advances in economic theory: Fifth world congress. Cambridge University Press, Cambridge.

[14] Eckel, K., Neary, J.P., 2005. Multi-product firms and flexible manufacturing in the global economy. Working paper. University of Oxford.

[15] Ethier, W.J., 2002. Political externalities, nondiscrimination, and a multilateral world. PIER Working Paper 02-030. University of Pennsylvania.

[16] Evenson, R., Westphal, L.E., 1995. Technological change and technology strategy, in: Behrman, J., Srinivasan, T.N. (Eds.), Handbook of development economics, Vol. 3a. North-Holland, Amsterdam, pp. 2209–2229.

[17] Grossman, G. M., Helpman, E., 2002. Integration versus outsourcing in industry equilibrium. Quarterly Journal of Economics 117, 85-119.

[18] Gruber, L, 2000. Ruling the world: power politics and the rise of supranational institutions. Princeton University Press, Princeton.

[19] Hausmann, R., Rodrik, D., 2003. Economic development as self-discovery. Journal of Development Economics 72, 603–633.

[20] Hausmann, R., Hwang, J., Rodrik, D., 2005. What you export matters. NBER working paper 11905.

[21] Hoff, K., 1997. Bayesian learning in an infant industry model. Journal of International Economics 43, 409–436.

[22] Johnson, H.G., 1953-1954. Optimum tariffs and retaliation. Review of Economic Studies 21, 142-53.

[23] Jovanovic, B., 1982. Selection and the evolution of industry. Econometrica, 50(3), 649-670.

[24] Krugman, P., 1979. Increasing returns, monopolistic competition, and international trade. Journal of International Economics 9, 469-479.

[25] Krugman, P., 1980. Scale economies, product differentiation, and the pattern of trade. American Economic Review 70, 950-959.

[26] Krugman, P., 1997. What should trade negotiators negotiate about? Review of Economic Literature 35, 113-120.

[27] Lee, P.M. 1989. Bayesian statistics: An introduction. Edward Arnold, London.

[28] Maggi, G., 1999. The role of multilateral institutions in international trade cooperation. American Economic Review 89, 190-214.

[29] Maggi, G., Rodriguez-Clare, A., 1998. The value of trade agreements in the presence of political pressures. Journal of Political Economy 106, 574-601.

[30] Maggi, G., Rodriguez-Clare, A., forthcoming. A political-economy theory of trade agreements. American Economic Review.

[31] Mayer, W., 1981. Theoretical considerations on negotiated tariff adjustments. Oxford Economic Papers 33, 135-53.

[32] McLaren, J., 2000. Globalization and vertical structure. American Economic Review 90, 1239-1254.

[33] Melitz, M., 2003. The impact of trade on intra-industry reallocations and aggregate industry productivity. Econometrica 71, 1695-1725.

[34] Melitz, M., Ottaviano, G., 2005. Market size, trade, and productivity. NBER working paper 11393.

[35] Nocke, V., Yeaple, S., 2006. Globalization and endogenous firm scope. Working paper. University of Pennsylvania.

[36] Pavcnik, N., 2002. Trade liberalization, exit, and productivity improvements: Evidence from Chilean plants. Review of Economic Studies 69, 245-276.

[37] Rhee, Y.W. 1990. The catalyst model of development: Lessons from Bangladesh's success with garment exports. World Development 18(2), 333–346.

[38] Rhee, Y.W., Belot, T., 1990. Export catalysts in low-income countries: A review of eleven success stories. World Bank Discussion Paper, Vol. 72, World Bank, Washington DC.

[39] Rosenberg, N., 1982. Inside the black box: Technology and economics. Cambridge University Press, Cambridge.

[40] Topalova, P., 2004. Trade liberalization and firm productivity: The case of India. IMF Working Paper WP/04/28.

[41] Trefler, D., 2004. The long and short of the Canada-U.S. free trade agreement. American Economic Review 94, 870-895.

[42] Tybout, J., 2003. Plant- and firm-level evidence on the "new" trade theories. In: Kwan Choi, E., Harrigan, J. (Eds.), Handbook of International Trade, Basil-Blackwell, Oxford.

[43] Urquiola, M., Andersen, L., Antelo, E., Evia, J.L., Nina, O., 1999. Geography and development in Bolivia. Migration, urban and industrial concentration, welfare, and convergence: 1950-1992. Working paper. Universidad Catolica Boliviana.

[44] Venables, A.J., 1987. Trade and trade policy with differentiated products: A Chamberlinian-Ricardian model. The Economic Journal 97, 700-717.