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À ma regrettée soeur cadette

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Abstract

This thesis is about international trade and development. Although external factors are important in understanding the situation of current developing countries, internal factors also need to be considered seriously. For instance, the conflicting interests of the various groups comprising the society might be crucial in explaining why some countries remain trapped in poverty while others seem to be doing pretty well. Focusing on any of those sets of factors can yield rather different insights on development issues, while pointing to some conflicting solutions.

The first essay builds upon the idea that gains from trade come from a certain degree of specialization among trade partners and challenges the view that specialization in the case of an agriculture-based developing country might imply a higher reliance on low skill labor. This view often leads to consider trade as a step away from the much awaited structural transformation of the economy, which can only come with increases in agricultural productivity. In this first chapter, we suggest that it needs not be the case. We show that trade openness can in fact trigger the structural transformation of such an agrarian society. It can induce a higher reliance on human capital accumulation and produce the necessary productivity gains for an economy to pick up. Our dynamic general equilibrium model provides a clear illustration of the mechanics behind such structural transformation.

Obviously, for the above mechanics to come into play, the provision of education resources needs be sufficient, allowing for permanent human capital accumulation over time. However, poverty may limit the supply of these resources, increasing the contest over their allocation as every group claims a higher share of it.

In the second essay, we do explore the political determinants of societies' tolerance for social exclusion on the basis of ethnicity, religion, or race. We develop a political-economic model in order to understand the emergence of social exclusion even in presence of a democratic voting system. To the extent that population size is, at least initially, the only source of asymmetry between rival groups, our analysis suggests that the introduction of democratic voting may not be sufficient to save small, but visible, minorities from social exclusion. Only where this asymmetry is moderate, can the introduction of democratic voting suffice to avoid some groups being excluded from sharing in on public education resources.

The last chapter of the thesis deals with the issue of child trafficking, a thriving business that can be linked to economic globalization. The chapter highlights key economic characteristics of this business and shows that the fight against child trafficking is far from trivial. Our analysis suggests that supply-side policies have very limited effect unless preceded by attacks on the demand side. We work within a model of a source country to highlight the necessary ingredients of a successful international cooperation towards the elimination of child trafficking.

Keywords: Trade; Extension services; Development; Social Exclusion; Democracy; Child Trafficking; Cooperation

Résumé

Cette thèse traite de questions liées au commerce et au développement international. S'il est vrai que dans un contexte d'intégration croissante des économies, la situation des pays en développement se comprend mieux en référence à des facteurs externes, l'on ne saurait ignorer l'importance de facteurs internes tels que la co-existence de groupes sociaux aux intérêts parfois divergeants. Chaque angle d'analyse peut ainsi apporter un éclairage différent sur la même réalité, suscitant autant de voies d'action possible.

Le premier essai explore les opportunités de développement liées au commerce international et ce du point de vue d'un petit pays ayant un avantage comparatif dans la production de biens agricoles. La production de biens agricoles nécessitant peu ou pas de main-d'œuvre qualifiée, il est coutume de considérer qu'une spécialisation dans ce type d'activité limite les chances de voir se former au sein de la société considérée une masse de capital humain suffisamment importante pour impulser la dynamique de développement qui passe par une accumulation substantielle de ce facteur. Ce chapitre propose une théorie de la transformation structurelle induite par le commerce international, où recherche scientifique et capital se combinent pour améliorer la productivité agricole et déclencher un progrès technique favorable aux travailleurs qualifiés. Le modèle élaboré illustre clairement les mécanismes en jeu et permettant à l'économie d'émerger de sa situation initiale de sous-développement.

La rareté des ressources jouant, des conflits de répartition peuvent naître de la volonté de certains groupes d'accroître la part qui leur est échue. Le deuxième chapitre élabore ainsi un modèle politco-économique dont le but est d'expliquer l'émergence de l'exclusion sociale au sein d'une société démocratique, exclusion basée sur l'ethnie, la race, ou la religion et qui consiste pour certains groupes à être exclus de la jouissance de ressources communes. Sur la base d'un modèle où à l'origine les groupes diffèrent uniquement par leurs tailles respectives, nous montrons qu'un système de vote démocratique n'est pas suffisant pour éliminer l'exclusion sociale au sein d'une société à forte asymétrie entre les groupes. Nos résultats suggèrent que seule une société dont les groupes sont de taille relativement comparable peut efficacement contrer l'émergence de l'exclusion sociale, aucun des groupes en présence n'ayant intérêt à la soutenir dans le cadre d'un vote démocratique.

Avec la globalisation des économies, se sont également développées toutes sortes d'activités illégales à l'instar du trafic international d'enfants dont les pays en développement sont très souvent les fournisseurs. Le troisième essai élabore ainsi un modèle économique dans le but de comprendre les déterminants d'un commerce en pleine expansion et illustre les limites d'une stratégie de lutte axée sur un seul aspect du marché, le côté offre en l'occurence. Le cadre d'analyse d'une économie sous-développée située à la source des flux de trafic nous permet de montrer la nécessité d'une meilleure coopération sur le plan international, et combinant des mesures tant du côté de l'offre que du côté de la demande.

Mots clés: Commerce; Recherche; Développement; Exclusion; Démocratie; Enfants.

General Introduction

Taking a look at today's developed nations in an historical perspective, one cannot help but notice a stark contrast between their current economic situation and that of some decades ago. Important changes along their economic and social structure across time appear to have propelled their societies out of a subsistence stage, and into a mass consumption one. This observation has inspired a linear theory of development in the tradition of Rostow (1960), who argues that growth in industrialization immediately follows subsistence and pre-conditions to take-off stages, leading to sustained growth and ultimately to high-mass consumption. Although this theory of development fits the historical experience of Western Europe societies, it seems to lack a real explanatory power when it comes to understanding why today's developing countries have failed to follow suit as to why current. Rostow's lecture on the development process is hence purely descriptive in the sense that there is no mention of the forces that allow a society to move from one stage to the next. However, Rostow's theory suggests that the development process is fundamentally dynamic.

The challenge facing economic development theorists is therefore to come up with some plausible answers to the real world differences that one observes both at the international level between countries and at the national level between individuals. Regardless of which approach one relies on, *i.e.* whether empirical, using data, or theoretical, all the contributions in this field aim at gaining more insight into the development process, so as to provide some useful policy recommendations. Therefore, there is no convincing reason as to why one approach should prevail over the other. Empirical investigations have the merit of overcoming the crucial issue of data availability, but are still subject to other concerns pertaining to data resorting - reliability of data sets, shortcuts of most econometric methods, etc. Likewise, the theo

retical approach is sometimes criticized because of the need to rely on some simplifying assumptions in order to solve models that would otherwise be highly complex.

Notwithstanding the above, the literature in this field and the numerous pieces of response to the issue of underdevelopment at least show how complex is the problem. Poverty appears to be a multifaceted reality both at the micro and the macro levels, such that its various aspects may hardy be uncovered at first glance. Under development may thus be tackled under different angles. Following Lucas (1988)on may stress the mechanics of economic development, in the sense that the emphasis is put on the forces which enable a society to move away from the subsistence stage, and ultimately to reach the mass consumption one. In this case we will be dealing with structural transformation, as economic development typically involves important changes in the way a society is organized along the social and economic dimensions. This is not to say that Lucas (1988) is the first to explore the issue, but that contribution is certainly a good illustration of a practice now widespread among development economists and stressing the role of human capital accumulation in the course of industrialization. The point is particularly relevant in a context of growing trade liberalization.

As a matter of fact, not only is the technological gap between today's developing countries and today's industrialized nations already huge, but the difference seems to be increasing as well. This observation has led many development institutions to recommend more trade liberalization since the 1980ies. Behind this recommendation is the idea that trade openness would facilitate technology import, allowing developing countries to catch up with more advanced economies so as to increase their productivity while experiencing a learning-by-doing process. In the long run, developing countries which have long been lagging from behind are suppose to take advantage of these interactions to develop some local technologies in substitution to the imported ones.

Lucas (1990) has pointed to the fact trade liberalization would not necessarily help the development cause of poor countries, except if they have the appropriate human capital needed to handle cutting-edge technologies. that line of reasoning then opened the door to a passionate debate question the capacity of poor countries to foster human capital accumulation within an international environment which surreptitiously pushes

their economy towards specialization in low-skilled labor intensive productions. This explains why some developing countries were, and are still reluctant to further open their economy to international trade, as they dread this may compromise their chances for a long time. Hence the dilemma facing the developing world, which has to choose between specialization and economic diversification in their development strategy. My contribution to this debate aims to show that product specialization in crop commodities does not necessarily preclude human capital accumulation, which implies that the possibility to experience structural transformation, *i.e.* industrialization remains. This is the focus of the first essay, where I consider a developing economy whose comparative advantage lies in crop production, and I investigate the conditions under which specialization in agricultural commodities may be a viable development strategy.

The possibility for a developing economy to experience sustained human capital accumulation following trade liberalization has already been extensively investigated in the literature. First contributions date as early as 1983: See Cartiglia (1997), Eichers (1999), and Ranjan (2001) for optimistic conclusions, and Findlay and Kierskowski (1983), Matsuyama (1992) and Stokey (1996) for the opposite. Given these two strands of the literature, my contribution lies in the novelty of the mechanism that I put forward to show how an agriculture-based economy might take advantage of international trade to foster human capital accumulation. For agriculture-based developing economy choosing to specialize in crop production, monitoring farm activities and providing farmers with improved inputs are of prime importance, especially if one is to achieve substantial productivity growth in agriculture. In my model, not only is the agricultural research and extension services sector the place for RD activities, but this intermediate sector is also responsible for providing technical assistance and monitoring farmers in implementing the latest technologies and using other improved inputs. Ultimately, the success of a product specialization strategy is conditional upon the agricultural research and extension services sector, effectively playing its role. By lowering the price of the import-competing good, trade liberalization causes the reallocation of physical capital towards agriculture, while skilled-labor flows into the skill-intensive, intermediate sector. These shifts then alter relative prices, rising the skill premium in wage which in

turn provides forward-looking individuals with the incentive to accumulate human capital. This process of human capital accumulation and the resulting productivity gains in agriculture therefore fuel the structural transformation of the economy in this model.

Notwithstanding the importance of agricultural research and extension services as described above, it appears that the highlighted mechanism may fail to come into play should skill labor fall short. This then points to the provision of educational resources as part of the strategy, given that the rising skill premium in wage already provides the required incentive for human capital accumulation on a private basis. Holding this way of reasoning makes it easier to understand why the quality of public institutions has drawn so much attention in recent as a major cause of underdevelopment. To the extent that provision of public educational resources is limited, there certainly is a strong temptation for some social groups to bias their allocation in such a way that benefits their own interest. Social exclusion on the basis of race, religion or ethnicity may then emerge within the society and gives rise to situations where some groups are frustrated in sharing in on common ressources. The second essay of my thesis is a contribution to this strand of the literature on public institutions in their relation with economic development, and aims at understanding the politico-determinants of social exclusion.

Existing models of social exclusion mainly put the emphasis on its economic consequences, stressing its detrimental effects on growth, - Easterly and Levine (1997), or its worsening effects with regards to income inequality - Gradstein and Schiff (2006). Incursions into the political determinants of social exclusion were initiated only recently with Gradstein (2003), Reynal-Querol (2005), and Gradstein and Schiff (2006). Reynal-Querol (2005) argues that social exclusion follows from a democratic voting system where people still strongly feel their affiliation to specific social groups, whereas Gradstein (2003) points to intra-group human capital externalities as a major factor. As both papers did not take the cost of exclusion into account, Gradstein and Schiff (2006) tried to do so by resorting to an exogenous cost taking the form a rebellion threat from those groups experiencing exclusion. However, not only is this exogenous cost questionable, but in addition, Gradstein and Schiff (2006) assumed that only marginalized groups have the option to privately invest in their offspring's education. The latter fea-

ture clearly stands at odd with the empirical evidence which shows that U.S. households all devote a significant share of their income to their children's education, no matter their income category.[1]

Unlike Gradstein and Schiff (2006) and in line with empirical observations, I develop a model where all households have the option to invest in their offspring's education. This feature makes the cost of social exclusion endogenous to household decisions, since resources allocation for participation into the exclusion group contest effort trades off private investment in one's child's human capital. My analysis then suggests that to the extent that population size is the only source of asymmetry between competing social groups, a democratic voting system cannot preclude the emergence of social exclusion, unless there is no clear majority. This is because absence a significant asymmetry in population sizes, no group is better off supporting social exclusion. However, as the asymmetry in population sizes increases, a society with high degree of social exclusion becomes interesting for the majority group, especially as each of its member only contributes a small amount into the group's contest effort, which leaves room for more private investment in the human capital formation of their offspring.

The analysis above clearly points to social exclusion with respect to public resources like education or health care, as a potential channel for intergenerational transmission of social status. Notwithstanding this feature, the fact that not all social groups can invest alike in the contest effort goes far beyond the sole human capital aspect, but rather illustrates a more general issue, which is, not all household can afford the same facilities to their offspring. In a broader setting where child wellbeing depends on parental investment, it is reasonable to think that in relative terms, wealthy households would devote more resources to their children.[2]

Furthermore, in extreme poverty situations where the household survival is at stake, it is not rare to see children called into rescue to help securing household income with some paid jobs. As such situations are more likely to arise in developing countries, this explains why development economics literature has been notably enriched in recent

[1] See the 2004 and 2005 Reports by the United States Department of Agriculture - USDA.
[2] This is clearly evidenced in USDA annual reports.

years with contributions on the child labor phenomenon - Basu and Van (1998), Dessy and Pallage (2001), etc. The fact that child workers can be hired to take part into the production process then raises the issue of their safety out of the familial frame, specially as some bad-entended individuals may be tempted to take advantage of their naivety. This certainly explains the adoption of several international conventions, aimed at preserving child's rights while protecting them from exploitative forms of labor - cf Convention C-182 of the International Labor Organization.

Notwithstanding the ongoing debate with regards to the welfare effets of such conventions - Dessy and Pallage (2005), Rogers and Swinnerton (2005), the question of their implementation deserves some investigation as well. As a matter of fact, far from being internal to some marginal countries, child trafficking, connected with the worst forms of child labor through the C-182 Convention, appear to be a transboundary phenomenon involving well-structured criminal networks.

In the context of a global world economy with substantial differences in living standards across countries, and assuming that both public and private resources are needed in providing children with a safe living environment, it is reasonable to wonder if the parents and the respective government of different countries, share the same capacity to provide their children with such an environment. The final essay of my thesis hence develops a two-sector, general equilibrium model where both parental and public resources are put into contribution to protect children against child-traffickers entrepreneurs in a small open economy . As traffickers are mainly motivated by the sake of profits, they typically adjust their effort to the price of a child victim on international markets. This setting allows me to show that because some countries are, at least in relative terms, more effective in protecting their children, the demand for child victims switches towards those countries which cannot provide a similar protection, rising the international price of child victims. Struggling with poverty and scarce resources, parents and government in the latter countries helplessly witness increased trafficking activities at home, explaining the international polarization of trafficking flows as can be seen in the data. My model points to a negative externality arising from some countries effectiveness on some others' ability to cope with child trafficking. My analysis therefore advocates the need

for a closer international cooperation, as well as the need to stress the role of demand factors in international conventions, a point that the C-182 Convention clearly misses.

Chapter 1

On the Mechanics of Trade-Induced Structural Transformation

ABSTRACT[1]

Gains from trade come from a certain degree of specialization among trade partners. Specialization in the case of an agriculture-based developing country might be feared to imply a higher reliance than ever on low skill labor. Trade might thus be seen as a step away from the much awaited structural transformation of the economy, which can only come with increases in agricultural productivity. In this chapter, we suggest that it needs not be the case. We show that trade openness can in fact trigger the structural transformation of such an agrarian society. It can induce a higher reliance on human capital accumulation and produce the necessary productivity gains for an economy to pick up. Our dynamic general equilibrium model provides a clear illustration of the mechanics behind such structural transformation.

1.1 Introduction

Many developing countries, particularly those from Sub-Saharan Africa, depend heavily on agricultural commodities for export earnings (UNCTAD, 2003). From the view-point of traditional trade theory, gains from trade come from specialization in goods for which

[1] Co-written with Stephane Pallage and Sylvain Dessy

a country has a comparative advantage.

Yet, industrial revolutions require structural transformations, which – one may reasonably fear – do not naturally derive from specialization in agriculture. "Globalisation," as anti-trade activists typically call the gradual removal of trade barriers, may increase the divide between rich and poor countries if it implies that agriculture-based countries are pushed away from the necessary conditions to achieve structural transformation. Catching up with industrialized countries would then be still further from reach.

In this chapter, we show that, unlike commonly believed, structural transformations can in fact be induced by a country's specialization in agriculture. Crucial to this process is the development of a sizable sector of agricultural research and extension services.[2]

As a services provision sector, agricultural research and extension relies intensively on skilled labor – agronomists and agricultural technicians – for the design and transfer of organizational methods, new crop varieties, management systems, production and marketing technologies. The development of the research and extension services sector is therefore of prime importance for agriculture-based developing countries. Yet, in these countries, shortage of skill supply seriously limits the availability of quality research and extension services to farmers, which in turn limits on-farm productivity growth. To the extent that structural transformations involve sustained growth in the relative proportion of skilled labor, we show in this chapter that a trade-induced specialization in agriculture can indeed enhance the development process of agrarian economies.

We formalize this idea using a three-sector intertemporal general equilibrium model. For the small agriculture-based economy we consider, trade openness has three direct effects. First, it lowers the relative price of the import-competing good, and pools both physical capital and skilled labor out of the import-competing sector. The skilled labor thus released may be absorbed by the research and extension service sector, while the released physical capital moves into the farming sector, as a complementary in-

[2]Agricultural extension encompasses a range of services aimed at expanding farmers' exposure to effective organisation and management skills, and to new technologies. It focuses on helping farmers master techniques and socioeconomic knowledge necessary to the improvement of the productivity of their farms.

put to agricultural research and extension. Second, it unleashes a process of capital-augmenting technical change that reduces the importance of unskilled labor relative to physical capital in farming. This causes farmers to substitute capital for unskilled labor as the demand for agricultural extension services rises. Third, trade-induced specialization causes the return to skill investment to rise, thus leading to an increase in the supply of skilled labor in the long-run.

The ability of agricultural research and extension services to generate aggregate productivity gains is by no means a purely theoretical idea. It has been shown that these services are responsible for a substantial share of TFP growth in India over the last three decades (Evenson *et al.*, 1999) and elsewhere (Evenson, 2001). Estimates of the economic impact of agricultural research and extension services vary across regions and crops. Evenson (2001) has computed the median estimated internal rate of returns to be above 40% for extension services and between 40 and 60% for agricultural research.

Our theory rests on the fact that capital and skills or the services they provide are complementary. This is a well-known fact in manufacturing, for instance (see Griliches, 1969, and the vast literature generated by this paper). It is also the case in agriculture where machines may replace large numbers of unskilled workers, but depend heavily on the availability of skills, to be operated efficiently, adapted to the land and to the crops. Research may also adapt the crops themselves to the soil and the machinery. Hamermesh (1993) compiles evidence of such capital-skill complementarity in many sectors, including agriculture.

The present chapter is connected to the literature on the human capital effects of trade liberalization. Sustained growth in per capita income involves a structural transformation of the economy, an important feature of which is the change in the skill composition of the labor force. For initially skill-scarce countries, static trade models predict that trade liberalization will cause a fall in the return to skill. This prediction raises the question of whether, in the long-run, and for an initially skill-scarce country, trade openness will cause this scarcity to persist. Efforts to address this question have essentially pitted two strands of the theoretical literature on trade openness and skill-supply dynamics. Contributions in the first strand include works by

Findlay and Kierzkowski (1983), Matsuyama (1992), and Stokey (1996). These authors argue that trade openness for an initially skill-scarce country will cause the scarcity of skills to persist in the long run. By contrast, the second strand of this literature, including contributions by Cartiglia (1997), Eichers (1999), and Ranjan (2001) overturn this prediction.

A common point in the second strand of this theoretical literature is the emphasis on the link between the costs of skill accumulation and the skilled labor wage. Since it takes skilled individuals to impart skills, a rise in the skilled labor wage has an adverse effect on skill-investment in the presence of credit constraints, because it raises education costs. These authors argue that trade openness for an initially skill-scarce country can correct this adverse credit-constraint effect, by inducing a fall in the skilled labor wage. This fall, in turn, by causing education costs to fall, leads to an increase in the proportion of individuals who invest in education. The result, they argue, is an increase in the supply of skilled labor in the long-run. However, since trade also induces a contraction of the import-competing sector, which is intensive in skilled-labor use, this prediction implies that the long-run increase in the supply of skilled labor will fail to benefit the export sector, which, by contrast, is intensive in unskilled labor. Indeed, trade-openness in these models seems to lead to growth in the education sector at the expense of the rest of the economy (namely the import-competing sector and the export sector): teachers are hired to train future teachers. In our model, the increase in the supply of skilled labor benefits the export sector in two ways. First, it leads to greater use of research and extension services in farming. Second, the increase in the supply of research and extension brought about by the increase in the skilled labor supply triggers a process of agricultural transformation whereby physical capital substitutes for unskilled labor.

Models in that second strand of literature appear to be at odds with existing empirical evidence regarding the link between trade openness and the skill-premium, because they imply a decrease is the skill-premium (understood as the ratio of the skilled and unskilled labor wages). Yet for many trade-liberalizing developing countries, available evidence reveals rising skilled labor supplies accompanied by non-declining skill-premia

(Robbins 1996; Arbache, Dickerson and Green, 2004).[3]

Unlike this literature, we obtain a positive association between trade openness and skill supply that is consistent with this empirical evidence. Our model retains some features of the second group of trade and factor accumulation models, except for some important features. First, unlike Cartiglia (1997), Eichers (1999) and Ranjan (2001), our non-traded sector produces an input for the export sector. Second, consistent with empirical evidence (for a survey of the empirical findings, see Hamermesh, 1993), we assume a strong substitutability between unskilled labor and capital. Third, the availability of agricultural research and extension services increases the importance of physical capital relative to unskilled labor in farm production. This is consistent with the evidence of a capital-skill complementarity in farming (Hamermesh, 1993).

Our chapter is also linked to the economic growth literature in which substantial ground has been gained on the understanding of the process of structural transformations (see, e.g. Laitner, 2000; Gollin, Parente, Rogerson, 2002) and the potential role of human capital (see, e.g. Temple and Voth, 1998). Our objective in this chapter is to show how the removal of trade barriers in an agriculture-based economy, while it calls for a stronger specialization in agriculture, can nevertheless trigger the process of structural transformation.

In the next section, we describe the model, which we analyse in depth in Section 3. We conclude in Section 4. We also provide some proofs in Section 5.

1.2 The model

We build an overlapping-generations, three-sector economy in which economic activities extend over an infinite number of periods. It operates in discrete time t. There are two final goods: a commercial crop (good a) which we take as the numeraire, and an import-competing good (m). Both final goods are tradable. In addition, there is an intermediate good (x), which is used as an input into the production of good a. This intermediate

[3]Other related contributions include Acemoglu (2002, 2003), and Desjounqueres, Machin and Van Reenen (1999).

good is nontradable. The nontradable good sector is the research and extension services sector, which provides technology-based solutions for relaxing on-farm yield constraints.

At the beginning of every period, a new generation of two period-lived heterogeneous agents is born. This new generation coexists with a generation of old agents. There is no population growth. Each generation has total population size normalized at unity.

Young agents are endowed with a level of physical capital, k, which they rent out to firms in the beginning of the first period of their life, at a market price r. They differ in their respective endowment of physical capital, and are distributed across capital levels according to a cumulative function, Ψ, with strictly positive p.d.f., ψ, over the bounded support, $\left[0, \bar{k}\right]$, $0 < \bar{k} < \infty$. The difference in capital endowment is the only source of inequality in this environment. Capital fully depreciates within a period.[4]

In their first period of life, all agents must decide whether to invest in skill accumulation or to supply unskilled labor to firms from that period on. In their second and last period, agents supply labor to firms in exchange for a wage, ω_i, which depends on their skill status i ($i = s$ if skilled, u if unskilled).

Let e be a binary variable taking value 1 if a young individual decides to invest in skill acquisition, and 0 if he elects to supply unskilled labor to firms. A young agent who chooses $e = 0$, supplements his capital income with an unskilled labor income in the first period, and remains an unskilled worker throughout his entire lifetime. In contrast, an agent who elects for $e = 1$ will forgo income from unskilled labor in the first period, in order to receive a skill-enhancing education, and so becomes a skilled worker in his second and last period of life. All education costs are pure opportunity costs.[5]

Let $y_{\tau t}(e, k)$ denote the income at time t of an agent of age $\tau \in \{1, 2\}$ having made

[4]Clearly, not allowing for capital accumulation is a simplifying assumption. Since it biases the results against structural transformations implying increases in the proportion of skilled workers, it is made without loss of generality. We will show that even absent capital accumulation, trade may lead to such structural transformations in an initially skill-scarce, agriculture-based economy. We thus take the strongest case against our claim.

[5]We abstract from education fees. One could argue that education fees are a function of education supply and demand as well as public expenditures on education. As a country opens up to trade, an increase in the demand for education may initially increase school fees, but as the supply of skilled labor increases, so should the supply of teachers and tax receipts. As a result the speed of structural transformation may be somewhat lower in early stages in a model with school fees. But our qualitative results would not change.

decision e when his endowment of capital was k:

$$y_{\tau t}(e,k) = \begin{cases} r_t k + (1-e)\,\omega_{ut} & \text{for } \tau = 1 \\ e\omega_{st} + (1-e)\,\omega_{ut} & \text{for } \tau = 2 \end{cases}$$

Let p_j denote the relative price of good j $(j = m, x)$. We use the small country assumption, i.e. the prices of exported/imported goods are exogenously determined by the international market. We also assume that the international market is stable so that these prices are constant over time.

In each period, a typical individual divides his income between the consumption of good a (denoted as C_a) and of good m (denoted as C_m). The lifetime utility of an agent born in period t is given by:

$$\mathbf{U}(c_{1t}, c_{2t+1}) = \ln c_{1t} + \ln c_{2t+1} \tag{1.1}$$

where $c_{\tau t} = (C_{a\tau t})^{\mu} (C_{m\tau t})^{1-\mu}$, $\mu \in (0,1)$. Agents choose their occupational strategy (e) by anticipating the consequences this choice will have on their lifetime utility which in turn depends on how much they consume in every period. By backward induction, forward-looking agents first determine their optimal lifetime utility given their occupational choice, then select the occupational option that yields the highest lifetime utility. As discounting is not central in the question we address, we assume no discounting to simplify the notation.

An agent's periodic budget constraint implies: $C_{a\tau t} + p_m C_{m\tau t} \leq y_{\tau t}(e,k)$. Given the utility function specified in (1.1), we can derive the following demand equations:

$$C_{a\tau t} = \mu y_{\tau t}(e,k) \tag{1.2}$$

$$C_{m\tau t} = (1-\mu)\frac{y_{\tau t}(e,k)}{p_m}. \tag{1.3}$$

The above demand schedules will prove useful when characterizing skilled and unskilled labor supplies.

1.2.1 Agents' occupational choices

At any date t, the supply of skilled labor is given by the total proportion, η_{st}, of skilled individuals. This figure equals the total proportion of adult agents who chose to invest in skill acquisition when young. Since all young agents are forward-looking, in choosing their occupation, they balance the future benefits against present education costs.

Let $V(e, k, M_t)$ denote the indirect lifetime utility of a young agent who makes occupational choice, e, in the first period, when he is endowed with a level of physical capital, k, and prices are given by the vector $M_t = (r_t, \omega_{ut}, \omega_{st+1}, \omega_{ut+1}, p_m)$. From (1.1), substituting in (1.2) and (1.3), yields:

$$\begin{aligned} V(e, k, M_t) &= \ln[r_t k + (1-e)\omega_{ut}] + \ln[e\omega_{st+1} + (1-e)\omega_{ut+1}] \\ &\quad - (1-\mu)\ln p_m + Z, \end{aligned} \tag{1.4}$$

with Z, a constant, residual term. Thus, a young agent will choose to invest in skill-enhancing education if his endowment, k, of physical capital satisfies:

$$V(1, k, M_t) \geq V(0, k, M_t) \ .$$

He will take employment as an unskilled worker otherwise.

Let $\vartheta(k, \theta_t, \pi_{t+1}) = V(1, k, M_t) - V(0, k, M_t)$ represent the net gain an agent derives from investing in skill acquisition in the first half of his life, when he is endowed with a level of physical capital k, and faces an opportunity cost of education, $\theta_t = \omega_{ut}/r_t$, and a future skill-premium, $\pi_{t+1} = \omega_{st+1}/\omega_{ut+1}$. Using (1.4), it can be established that:

$$\vartheta(k, \theta_t, \pi_{t+1}) = \ln\left[\frac{k}{k+\theta_t}\right] + \ln \pi_{t+1} \ . \tag{1.5}$$

As can be inferred from (1.5), *ceteris paribus*, the net gain from investing in skill rises with the agent's physical capital endowment, k, or with the future level of the skill-premium, π_{t+1}, while it drops with a rise in the opportunity cost of this investment.

Since ϑ is increasing in k, young agents who benefit from investing in skill acquisition

are necessarily those endowed with a level of physical capital higher than a threshold, k_t^*, which characterizes an indifferent agent. The threshold solves equation $\vartheta(k, \theta_t, \pi_{t+1}) = 0$. Using (1.5), we find k_t^* to be:

$$k_t^* = \frac{\theta_t}{(\pi_{t+1}) - 1} \ . \tag{1.6}$$

Equation (1.6) calls for two remarks. First, in absence of any positive skill premium (if $\omega_{st+1} = \omega_{ut+1}$), there does not exist a level of endowment such that education is worthwhile ($k^* \to \infty$). Second, as the skill premium π_{t+1} becomes large, then $k_t^* \cong \theta_t/\pi_{t+1}$, i.e. the threshold endowment of physical capital is approximately the inverse of a measure of the return to education. Let R_t denote this return:

$$R_t = \frac{\pi_{t+1}}{\theta_t} \ . \tag{1.7}$$

The threshold endowment of physical capital is thus approximately:

$$k_t^* \cong \frac{1}{R_t}, \qquad \text{all } t. \tag{1.8}$$

Aside from the fact that it is very easy to interpret, this approximation is very useful for the derivation of an analytical solution to our model. Since it is reasonable to think that π is large in developing countries in which skills are in short supply, we will use this approximation henceforth.

The number of young agents who choose to work as unskilled labor is given by $\Psi(k_t^*)$. As $\Psi(k_t^*) \cong \Psi(1/R_t)$, the total number, n_t, of young agents who will become skilled individuals in their second period of life is simply:

$$n_t \cong 1 - \Psi(1/R_t) \ , \tag{1.9}$$

all $t = 0, 1, ...$ Given the properties of the function, Ψ, it follows from (1.8) that any exogenous factor that raises the return to education tends to cause an increase in the proportion of young agents who choose to forgo unskilled-labor income in order to invest

in skill-enhancing education:

$$\frac{\partial n_t}{\partial R_t} > 0 .$$

However, in a general equilibrium, the return to education, R_t, will also adjust to changes in n_t, and we must take this into consideration when analyzing the effects of trade openness in this initially skill-scarce, agriculture-based economy.

In period t, the total supply of skilled labor is the proportion of agents who chose to invest in skill-acquisition in period $t-1$. In contrast, the total supply of unskilled labor in period t, is composed of two different generations of agents: old agents who did not attend school in period $t-1$ (in total number $1-n_{t-1}$), and young agents who elect to work from period t on (in total number $1-n_t$). Therefore, letting η_{it} denote the total supply of labor of quality i $(i = s, u)$ in period t, we have:

$$\eta_{st} = n_{t-1} \tag{1.10}$$

$$\eta_{ut} = 2 - n_t - n_{t-1}, \tag{1.11}$$

$t = 0, 1, ...$

A structural transformation in this economy can thus be captured by the law of motion for η_{it}, itself determined by the law of motion of n_t. To further characterize these laws of motion, we now explicitly model the supply side of the economy.

1.2.2 Production and factor prices

In this subsection, we describe the production technologies for all goods produced in this economy. For convenience we temporarily drop the time subscript, except when absolutely necessary.

Production of the import-competing good

Production of the import-competing good m requires physical capital (K_m) and skilled labor (S_m). Output in this sector is described by a standard Cobb Douglas technology:

$$Y_m = (K_m)^{\alpha} (S_m)^{1-\alpha}, \qquad \alpha \in (0,1)$$

Profit-maximization by perfectly competitive firms leads to the following factor demand schedules:

$$\omega_{sm} = (1-\alpha)\, p_m \left(\frac{K_m}{S_m}\right)^{\alpha} \tag{1.12}$$

$$r_m = \alpha p_m \left(\frac{K_m}{S_m}\right)^{\alpha-1}. \tag{1.13}$$

The research and extension services sector

This sector produces research and extension services, using skilled labor only.[6] Workers in this sector are agronomists and/or agricultural technicians. They do research and technically assist farmers in raising on-farm productivity. The representative firm's output, Y_x, is given by:

$$Y_x = (S_x)^{1-\alpha}. \tag{1.14}$$

Profit maximization in this nontradable sector leads to the following wage:

$$\omega_{sx} = (1-\alpha)\, p_x\, (S_x)^{-\alpha}, \tag{1.15}$$

[6] In our model, agricultural research and extension services are assumed to be privately provided. In areas dominated by commercial farming, private sector involvement in the provision of extension services seems to be a natural mechanism for addressing farmers' needs in ever-changing agro-ecological environments (World Bank, 1997). With the increased commercialisation of agriculture in many developing countries, it seems therefore appropriate to assume a private provision of research and extension services. In practice, many developing countries, often with the help of The World Bank, have created competitive private-sector networks of extension consultants to deliver inputs and technology to private farmers (Schultz et al., 1996). Umali-Deininger (1996) also documents the involvement of private consulting firms in the provision of extension services in countries such as Argentina, Brazil, Colombia, Mexico, Uruguay, Korea, and Taiwan.

where p_x denotes the relative price of extension services. Assuming skills are perfectly transferable across sectors, the economy faces the following resource constraint in the skilled labor market: $S_m + S_x \leq \eta_s$.

The farming sector

Research and extension services have been an important input for agricultural development in most developing countries (Evenson and Mwabu, 1998; Evenson, Pray and Rosegrant, 1999; Evenson, 2001; Owens *et al.* 2003), along with capital, land and labor. To keep the focus on the importance of research and extension services, we abstract away from land as an input into farming. Farming in our model essentially requires the use of agricultural research and extension services, X, physical capital, K_a, and unskilled labor, U. Adding land to such model would make the analysis more complex without qualitatively affecting the results.

The production function we use is CES in capital and unskilled labor and Cobb Douglas in research and extension services. This production function captures two important features of agricultural production: the easy substitutability of physical capital and unskilled labor and their complementarity with agricultural research and extension services.[7] Production functions of this type are now commonly used in multifactor models in which the elasticities of substitution may vary between pairs of factors. Fallon and Layard (1975) use a double CES form whereas Stokey (1996), Greenwood and Seshadri (2002), Krusell, Ohanian, Ríos-Rull and Violante (2000) and Maoz and Moav (2004) use a form closer to ours. Agricultural output in our model is given by:

$$Y_a = X^{1-\alpha} \left[\phi\left(\bar{X}\right) K_a + U\right]^{\alpha}, \tag{1.16}$$

where $\bar{X}$ denotes the total supply of extension services, and $\phi\left(\bar{X}\right)$ measures the technical progress on the productivity of physical capital brought about by overall agricultural

[7]The assumption of a strong substitutability of unskilled labor and capital is supported by a large body of empirical evidence surveyed in Hamermesh (1993). Evidence of a complementarity between skills and capital in farming can also be found in Hamermesh (1993). In manufacturing, the capital-skill complementarity has been extensively documented since Griliches (1969).

research and extension services. The assumption of a capital augmenting technical progress in the sense of Solow is a simplifying assumption to keep the analysis tractable. For simplicity also, we set:

$$\phi\left(\bar{X}\right) = \bar{X}^{\varepsilon}, \qquad 0 < \varepsilon < 1 \tag{1.17}$$

In equilibrium, demand equals supply: $X = \bar{X}$. Since good X is nontradable, domestic market-clearing implies that:

$$X = Y_x. \tag{1.18}$$

Under perfect competition, profit-maximization leads to the following factor demand schedules:

$$p_x = (1-\alpha)\left[\frac{\phi(X)\,K_a + U}{X}\right]^{\alpha} \tag{1.19}$$

$$\omega_u = \alpha\left[\frac{\phi(X)\,K_a + U}{X}\right]^{\alpha-1}, \tag{1.20}$$

$$r_a = \alpha\phi(X)\left[\frac{\phi(X)\,K_a + U}{X}\right]^{\alpha-1}. \tag{1.21}$$

Denoting by K the aggregate stock of physical capital, we can write the resource constraint in the capital market as follows:

$$K_a + K_m \leq K, \quad \text{with } K = \int_0^1 k dk\,.$$

Since $\varepsilon \in (0,1)$, it is straightforward to show using (1.20) and (1.21) that growth in agricultural research and extension services will raise the marginal productivity of both physical capital and unskilled labor, but the magnitude of this increase will be higher for physical capital, thus initiating the process of capital-augmenting technical change in agriculture.

1.3 Equilibrium effects

In this section, we examine the effects of trade openness on the structure of the labor force, and their implication for the development of the extension services sector. We begin by defining an equilibrium in the context of a small open economy.

Definition 1.1: [Equilibrium] *An intertemporal general equilibrium for this initially skill-scarce, agricultural, open economy is a sequence of prices,* $\{p_{xt}^*, r_{at}^*, r_{mt}^*, \omega_{ut}^*, \omega_{sxt}^*, \omega_{smt}^*\}_{t=0}^{\infty}$, *a sequence of threshold physical capital endowments,* $\{k_t^*\}_{t=0}^{\infty}$, *a sequence of school-goers,* $\{n_t^*\}_{t=0}^{\infty}$, *a sequence of intersectoral allocation of inputs,* $\{K_{at}^*, K_{mt}^*, S_{xt}^*, S_{mt}^*, U_t^*, X_t^*\}_{t=0}^{\infty}$, *a sequence of returns to education* $\{R_t^*\}_{t=0}^{\infty}$, *and a sequence of relative supply of skilled and unskilled labor* $\{\eta_{st}^*, \eta_{ut}^*\}_{t=0}^{\infty}$, *such that, for all t:*

(i) given $\left(p_m, p_{xt}^*, \eta_{st}^*, \eta_{ut}^*, \eta_{st+1}^*, \eta_{ut+1}^*, \omega_{sxt}^*, \omega_{smt}^*, \omega_{ut}^*, K\right)$, $X_t^* = (S_{xt}^*)^{1-\alpha}$, S_{xt}^* *satisfies (1.15),* S_{mt}^* *satisfies (1.12),* K_{at}^* *satisfies (1.21),* K_{mt}^* *satisfies (1.13), and* U_t^* *satisfies (1.20);*

(ii) $\omega_{sxt}^* = \omega_{smt}^* = \omega_{st}^*$ *and* $r_{at}^* = r_{mt}^* = r_t^*$;

(iii) given (K_{at}^*, U_t^*, X_t^*), p_{xt}^* *satisfies (1.19);*

(iv) given $\left(p_m, p_{xt}, \eta_{st}^*, \eta_{ut}^*, \eta_{st+1}^*, \eta_{ut+1}^*, K\right)$, R_t^* *satisfies (1.7);*

(v) given k_t^*, n_t^* *satisfies*

$$n_t = 1 - \Psi\left(k_t^*\right) \; ; \tag{1.22}$$

(vi) given $\left(p_m, \eta_{st}^*, \eta_{ut}^*, \eta_{st+1}^*, \eta_{ut+1}^*, K\right)$, k_t^* *satisfies (1.8);*

(vii) η_{st}^* *and* η_{ut}^* *, satisfy*

$$\begin{aligned} \eta_{st}^* &= n_{t-1}^* \\ \eta_{ut}^* &= 2 - n_t^* - n_{t-1}^*; \end{aligned}$$

(viii) all markets clear.

In a model like ours, the picture of the general equilibrium effects of trade openness can be quite blurry. To clarify this picture, we restrict attention to long-term effects by

emphasizing the economy's behavior along the steady state.

Definition 1.2: [Steady state equilibrium] *A steady state equilibrium is a general equilibrium, which in addition satisfies* $n_t^* = n_{t-1}^* = n^*$, *for all* t, *where* n^* *denotes the steady-state proportion of individuals who invest in skill acquisition.*

Combining the definition of a steady state equilibrium, with conditions (iv) and (vi) of a general equilibrium, it follows that

$$n^* = 1 - \Psi\left(k_t^*\right) \tag{1.23}$$

which implies that $k_t^* = k^*$ at the steady state. This in turn, implies that the return to education, R_t^*, remains constant: $R_t^* = R^*$.

1.3.1 The determinants of the steady state return to education

Next, we characterize the equilibrium return to education as defined in (1.7) at the steady state. Since capital moves freely across sectors, capital market clearing implies that the rental rate of capital will be equalized across sectors: $r_a = r_m = r$. Intersectoral mobility of skilled labor also results in equal wages for this factor: $\omega_{sx} = \omega_{sm} = \omega_s$.

Lemma 1.1. *The demand for skilled labor in the nontradable sector is given by:*

$$S_x = \bar{A}\left(p_m\right)^{-\delta}, \tag{1.24}$$

$$\text{where } \delta = 1/\alpha\left(1-\alpha\right)\left(1-\varepsilon\right) \text{ and } \bar{A} = \left(1-\alpha\right)^{(1-\alpha)\delta}. \tag{1.25}$$

Proof: See appendix. ■

Since $\delta > 0$, Lemma 1.3.1 establishes that a rise (a decline) in the relative price of the import-competing good causes the demand for skilled labor in the intermediate-good sector to decline (rise):

$$\frac{dS_x}{dp_m} < 0\,.$$

This is quite intuitive as both the import-competing and the research and extension

sectors have a competing claim on the supply of skilled labor. Our next step is to characterize the steady-state return to education, R^*.

The steady state opportunity cost of education, after substituting in (1.20) and (1.21), is:

$$\theta^* = \frac{1}{\phi(X)}$$

Combining (1.16) and (1.17), using market-clearing conditions and substituting in (1.24) yields:

$$\theta^* = \left(\bar{A}\right)^{-(1-\alpha)\varepsilon} (p_m)^{\bar{\delta}}, \tag{1.26}$$

where $\bar{\delta} = \delta\varepsilon(1-\alpha)$. For a small economy with initially a comparative advantage in the production of the agricultural good, trade openness (i.e., a decline in p_m) lowers the opportunity cost of education:

$$\frac{\partial\theta^*}{\partial p_m} > 0.$$

This is because trade openness triggers a process of technological progress that raises the importance of physical capital relative to unskilled labor in farming. We see from (1.26) that growth in the economy-wide stock of physical capital has no effect on the opportunity cost of education.

The next lemma characterizes the skill-premium, i.e. the skilled to unskilled labor wage ratio.

Lemma 1.2. *The steady-state skill-premium is:*

$$\pi^* = \frac{\lambda}{n^*}\left[(p_m)^{-\bar{\delta}} K + (1-n^*)\nu\right], \tag{1.27}$$

$$\text{where } \lambda = \frac{(1-\alpha)}{\alpha}\bar{A}^{(1-\alpha)\varepsilon} \text{ and } \nu = 2/\bar{A}^{(1-\alpha)\varepsilon}.$$

Proof: See appendix. ■

As can be seen from (1.27), for a small economy with initially a comparative advantage in the production of the agricultural good, the partial equilibrium effects of trade

openness (i.e., a decline in p_m) on the skill-premium are unambiguously positive:

$$\frac{\partial \pi^*}{\partial p_m} < 0,$$

since $\bar{\delta} > 0$. In contrast, an exogenous increase in the supply of skilled labor, n^*, tends to reduce this skill-premium:

$$\frac{\partial \pi^*}{\partial n^*} < 0 .$$

Furthermore, since

$$\frac{\partial \pi^*}{\partial K} > 0 ,$$

growth in the stock of physical capital will tend to raise the skill-premium. This result follows from easy substitutability between physical capital and unskilled labor. Growth in the economy-wide stock of physical capital, by decreasing the cost of physical capital, induces the substitution of physical capital for unskilled labor in farming, thus causing the wage for unskilled labor to decline. Because growth in the demand for physical capital in farming raises the marginal productivity of agricultural research and extension services, demand for these services will rise, thus leading to an increase in the skilled labor wage, as supply adjusts to demand. Hence the increase in the skill-premium.

Lemmas 1.3.1 and 1.3.1 together imply that the steady-state return to education can be written as:

$$R^* = \left[(p_m)^{-\bar{\delta}} K + (1 - n^*) \nu \right] (p_m)^{-\bar{\delta}} (n^*)^{-1} \bar{\lambda}, \tag{1.28}$$

where $\bar{\lambda} = \lambda \bar{A}^{(1-\alpha)\varepsilon}$. The partial equilibrium effects of trade openness on the return to education are straightforward. As can be seen from (1.28), the steady-state return to education tends to rise with trade openness (i.e., a decline in p_m):

$$\frac{\partial R^*}{\partial p_m} < 0 .$$

A rise in the economy's stock of physical capital, K, also positively affects the steady

state return to education:

$$\frac{\partial R^*}{\partial K} > 0 .$$

Hence, growth in the economy-wide stock of physical capital will raise the return to education. Indeed, it causes an increase in the skill-premium, without causing a decline in the opportunity cost of education. However, the return to education tends to decrease with an exogenous increase in the supply of skilled labor:

$$\frac{\partial R^*}{\partial n^*} < 0 .$$

Therefore since n^* will adjust to changes in p_m, it follows that the general equilibrium effects of trade openness on the return to education are not clear-cut. They are the sum of two different effects: a direct effect (i.e., $\partial R^*/\partial p_m$) and an indirect effect ($[\partial R^*/\partial n^*]\,\partial n^*/\partial p_m$). As the next subsection will show, the partial derivative of n^* with respect to p_m is negative. The general equilibrium effects of trade openness on the return to education are therefore ambiguous.

1.3.2 Trade openness and skill accumulation

Our next task is to determine the long-term effects of trade openness on the supply of skilled labor for a small, agriculture-based economy. We start by establishing the existence and uniqueness of the steady state equilibrium.

Using conditions (1.23) and (1.28), we obtain the following condition for the existence of a steady-state equilibrium:

$$n = f(n, p_m, K) \tag{1.29}$$

where

$$f(n, p_m, K) = 1 - \Psi\left[\frac{\bar{\lambda}^{-1}(p_m)^{\bar{\delta}} n}{\left[(p_m)^{-\bar{\delta}} K + (1-n)\nu\right]}\right].$$

Equation (1.29) is a well-defined fixed-point problem, owing to the properties of the function f. A number of observations can be made from equation (1.29). First, since the domain of the function Ψ is bounded below by $k = 0$, then $\Psi(0) = 0$, so

that $f(0, p_m, K) = 1$. This means that there does not exist a steady-state equilibrium without skilled labor. In other words, any steady state equilibrium of this economy satisfies $n^* > 0$.

Moreover, we know that the poorest young agents in this economy, those with zero capital endowment, will necessarily choose to supply unskilled labor to firms. Hence an equilibrium with no unskilled agents does not exist either. This can be confirmed by the fact that $f(1, p_m, K) = 1 - \Psi[\frac{\bar{\lambda}^{-1}(p_m)^{2\delta}}{K}] < 1$ as $\frac{\bar{\lambda}^{-1}(p_m)^{2\delta}}{K} > 0$. So any equilibrium of this economy satisfies $0 < n^* < 1$.

Finally, as the function Ψ is strictly increasing, by construction, f is strictly decreasing in n and p_m. In contrast, f is strictly increasing in the economy-wide stock of physical capital, K. Hence Brouwer's fixed-point theorem may be applied to establish the existence of a steady state equilibrium:

Proposition 1.1: *There exists a unique* $n^* \in (0,1)$, *such that* $n^* = f(n^*, p_m, K)$, *and*

$$(i) \quad \frac{\partial n^*}{\partial p_m} < 0$$
$$(ii) \quad \frac{\partial n^*}{\partial K} > 0 .$$

Properties (i) and (ii) of Proposition 1.1 follow from a direct application of the Implicit function theorem. Property (i) states that in the long run, trade openness raises the supply of skilled labor in an initially skill-scarce agriculture-based country. This is the substance of a trade-induced structural transformation. A country's openness to trade initiates deep changes in the structure of the labor force with a drop in unskilled labor (easily replaced by physical capital) in farming. When this happens, the return to education rises, thus raising the number of individuals who benefit from investing in skill-enhancing education.

Property (ii) states that an inflow of physical capital in the economy will increase the supply of skilled labor in the long run. There are two underlying reasons for this result. First, because of the easy substitutability between physical capital and unskilled labor in

agriculture, an increase in the supply of physical capital causes a proportional decrease in the marginal productivity of each of the two inputs, thus leaving unchanged the opportunity cost of skill-investment. Second, because physical capital and agricultural research and extension services are complementary, a higher supply of physical capital increases the productivity of research and extension, thus leading to an increase in the market demand for these services. Since the research and extension services sector is intensive in skilled labor, in the long run, the rise in the demand for these services will stimulate the demand for skills, thus raising the skill premium.

Globalisation changes many aspects of life in a small, agriculture based society. Those who fear that taking part in world trade might exacerbate the scarcity of skilled labor in such country may find some hope in the teachings of this chapter. Trade does not move a poor country away from the economic progress associated with structural transformations.

1.4 Concluding remarks

This chapter examines the forces underlying the structural transformation of a small economy with initially a comparative advantage in the production of agricultural commodities. To explore the nature of these forces, we use a three-sector intertemporal general equilibrium model, with two final goods and one intermediate, nontradable good. Our model identifies three main ingredients for a successful process of structural transformation. The first is the substitutability of physical capital for unskilled labor in farming. The second is a capital-augmenting process of technical change in farming induced by a greater availability of agricultural research and extension services. The third is trade openness itself, which, in the long-run, leads to an increase in the relative supply of skilled labor.

Previous studies imply that this increase in the relative proportion of skilled individuals fails to benefit the export sector, which they model as unskilled-labor intensive (e.g. Cartiglia 1997). Our model reverses this prediction by modeling the farming sector explicitly and accounting for the complementarity between capital and research and

extension services (intensive in skills). This ensures that the export sector (i.e., the farming sector) directly benefits from the trade-induced increase in the supply of skilled labor. The latter strengthens its international competitiveness.

Our message to policy makers is two-fold. First, specialization in agriculture can be an engine of structural change if the barriers to quality education are not too big. In this chapter, we have assumed that the cost of education is the opportunity cost for a young agent of not working. A trade-induced structural transformation will be all the more powerful if the government makes education one of its most important policies. The availability of affordable quality education is essential for the mechanics we have highlighted in this chapter to work. Second, trade may lead to a serious shrinking of the import competing sector. Our analysis suggests that protecting this uncompetitive sector against all odds may not be an effective way to stimulate the accumulation of human capital.

Our message to anti-trade activists is simple. Relax! Trade and the specialization it implies do not wipe out the hopes for poor countries to move away from poverty. On the contrary, trade can be an important engine of structural revolution.

1.5 Appendices

Proof of Lemma 1: First, using (1.13) and (1.21), equal rental rates in equilibrium imply:

$$p_m \left[\frac{\phi(X) K_a + U}{X}\right]^{1-\alpha} = \phi(X) \left(\frac{K_m}{S_m}\right)^{1-\alpha}. \tag{1.30}$$

Second, using (1.12) and (1.15), equal skilled-labor wages in equilibrium imply:

$$p_x = p_m \left(\frac{S_x K_m}{S_m}\right)^{\alpha}. \tag{1.31}$$

Third, combining (1.31) and (1.19) and rearranging terms yields:

$$\frac{\phi(X) K_a + U}{X} = \gamma (p_m)^{1/\alpha} \left(\frac{K_m}{S_m}\right) S_x, \tag{1.32}$$

with

$$\gamma = \left(\frac{1}{1-\alpha}\right)^{1/\alpha}. \tag{1.33}$$

Finally, using (1.30), (1.32), (1.14) and (1.17), as well as market-clearing conditions yields the result. ■

Proof of Lemma 2: We have $\pi_t = \omega_{st}/\omega_{ut}$. Using (1.12) and (1.20), we can write the steady-state skill-premium as follows:

$$\pi^* = \left(\frac{1-\alpha}{\alpha}\right) p_m \left[\frac{\phi(X^*) K_a^* + U^*}{X^*}\right]^{1-\alpha} \left(\frac{K_m^*}{S_m^*}\right)^{\alpha}.$$

Substituting in (1.30) and rearranging terms yields:

$$\pi^* = \frac{1-\alpha}{\alpha} \phi(X^*) \left(\frac{K_m^*}{S_m^*}\right). \tag{1.34}$$

The resource constraint implies $K_a^* = K - K_m^*$. Substituting this expression in (1.32), rearranging terms yields:

$$\frac{\phi(X^*) K_a^* + U^*}{X^*} = \left[\gamma (p_m)^{1/\alpha} \frac{X^* S_x}{\phi(X^*)} + S_m^*\right] \left(\frac{K_m^*}{S_m^*}\right)$$

which implies that:

$$\frac{K_m^*}{S_m^*} = \frac{\phi(X^*)\,K_a^* + U^*}{X^*}\left[\gamma\,(p_m)^{1/\alpha}\,\frac{X^* S_x}{\phi(X^*)} + S_m^*\right]^{-1}. \tag{1.35}$$

Now, substituting (1.35) in (1.34) and rearranging terms yields:

$$\pi^* = \frac{1-\alpha}{\alpha}\left[\frac{[\phi(X^*)K + U^*]}{\gamma\,(p_m)^{1/\alpha}\,[\phi(X^*)]^{-1}\,X^* S_x + S_m^*}\right].$$

Using (1.17) and (1.24) and market-clearing conditions, we find:

$$\pi^* = \frac{1-\alpha}{\alpha}\left[\frac{(p_m)^{\delta-\bar{\delta}}\,\bar{A}^{(1-\alpha)\varepsilon}K + 2\,(p_m)^{\delta}\,(1-n^*)}{\left(\gamma\bar{A}^{(1-\alpha)(1-\varepsilon)} - 1\right)\bar{A} + (p_m)^{\delta}\,n^*}\right],$$

where $\bar{A} = (1-\alpha)^{(1-\alpha)\delta}$ and $\bar{\delta} = \delta\varepsilon\,(1-\alpha)$.

Using (1.25) and (1.33), it can be shown that:

$$\left(\gamma\bar{A}^{(1-\alpha)(1-\varepsilon)} - 1\right)\bar{A} = \left(\frac{\alpha}{1-\alpha}\right)(1-\alpha)^{\delta(1-\alpha)}.$$

Therefore, for appropriately chosen $\alpha \in (0,1)$ and $\varepsilon \in (0,1)$, we can have:

$$\left(\gamma\bar{A}^{(1-\alpha)(1-\varepsilon)} - 1\right)\bar{A} \to 0$$

so that:

$$\pi^* = \frac{\lambda}{n^*}\left[(p_m)^{-\bar{\delta}}\,K + (1-n^*)\,\nu\right],$$

where

$$\begin{aligned}\lambda &= \frac{1-\alpha}{\alpha}\bar{A}^{(1-\alpha)\varepsilon} \\ \nu &= 2\bar{A}^{-(1-\alpha)\varepsilon}.\end{aligned}$$

This completes the proof. ■

Chapter 2

Democratic Voting and Social Exclusion

ABSTRACT[1]

This chapter explores the political determinants of societies' tolerance for social exclusion on the basis of ethnicity, religion, or race. We develop a political-economic model of social exclusion with three main features. First, each individual living in this society must submit a political proposal regarding the extent to which society must tolerate social exclusion. Second, depending on the realized degree of society's tolerance for social exclusion, each population group comprising the society must decide on how much resource to expend in order to exclude rival groups from, or include members of their group in, the public allocation of education resources. Third, allocation of resources to participation in the exclusion contest trades off private investment in child's human capital. To the extent that population size is, at least initially, the only source of asymmetry between rival groups, our analysis suggests that the introduction of democratic voting may not be sufficient to save small, but visible, minorities from social exclusion. Only where this asymmetry is moderate, can the introduction of democratic voting suffice to eliminate social exclusion.

2.1 Introduction

In public discussions of the role of institutions in the process of development, the introduction of democratic voting is often seen as a panacea--a cure for all social ills. Social

[1] Co-written with Sylvain Dessy

exclusion[2], however, is a problem faced by democracies and dictatorships alike [William Easterly and Ross Levine (1997; Alberto Alesina, William Easterly, and Reza Baqir (1999), Mark Gradstein and Moshe Justman (2002)]. Consider a socially heterogeneous country, where population groups are polarized along ethnic, religious or racial lines. Whether individuals comprising such a society will have equal access to the constituents of welfare, regardless of their population group of affiliation, may therefore depend on whether social exclusion is tolerated. A necessary condition for social exclusion to be tolerated is that politicians have ethnic, racial, or religious-based constituencies, which may lead to the exclusion of the politically dominated population groups from the constituents of welfare. It is not therefore surprising that such exclusion has been shown to have a negative effect on economic growth [William Easterly and Ross Levine (1997); Mark Gradstein and Moshe Justman (2002)], and to lead to an unequal distribution of wealth across population groups [Mark Gradstein and Maurice Schiff (2006)]. Why is this phenomenon tolerated in some societies? More importantly, if individuals comprising a socially heterogeneous society were to vote democratically on the extent to which their society must tolerate social exclusion on the basis of ethnicity, religion, or race, what would be the outcome of this vote and why? Under what conditions does democratic voting eliminate social exclusion? These are the questions we address in this chapter.

Basic economic theory of social exclusion or marginalization reveals that participating in the exclusion contest entails costs, not just benefits, to the participants [Mark Gradstein (2003); Jose G. Montalvoa, and Marta Reynal-Querol (2005)]. By backward induction, therefore, one would expect a population group to support tolerance of social marginalization of rival groups only if, for members of that group, the benefits of socially marginalizing others outweigh its costs. The costs of marginalizing others may take the form of resources - time and/or money, members of a population group must expend in order to block rival groups' access to publicly provided resources such as health services, education [e.g., Mark Gradstein (2003)], or to public goods [e.g., Alberto Alesina,

[2]In this chapter social exclusion refers to the exclusion of rival social groups from the constituents of welfare on the basis of race, religion, or ethnicity, for example. Indicators of social exclusion relate to economic activity, employment, housing, health, and other factors.

William Easterly, and Reza Baqir (1999)]. The benefits may be measured, for instance, in terms of the share of existing public resources this group can capture for the exclusive use of its members [e.g., Mark Gradstein (2003)]. In this chapter, we develop a political-economic model of population groups competition for education resources with three main features. First, each individual living in this society must submit a political proposal regarding the extent to which society must tolerate social exclusion. Second, depending on the realized degree of society's tolerance for social exclusion, each population group comprising the society must decide on how much resources to expend in order to exclude rival groups from public allocation of education resources. Third, allocation of resources to participation in the exclusion contest trades off private investment in child's human capital.

Within each population group, members correctly anticipate that, if selected, their political proposal on the extent of society's tolerance for social exclusion will have an effect on the intensity of the exclusion contest. Therefore, we first characterize the outcome of the exclusion contest as a Nash-Equilibrium of a non-cooperative game between rival groups, given the realized degree of tolerance for social exclusion. Depending upon his population group of affiliation, and depending upon the outcome of the exclusion contest, each individual then receives a payoff from living in a society with degree of tolerance, say δ, for social exclusion. In a political equilibrium with democratic voting over the level of δ, each individual then chooses the political proposal, δ, that maximizes this payoff.

We use this political-economic framework to argue that in a context where individuals are allowed to vote democratically on the extent of society's tolerance for social exclusion, if population groups are either symmetric in exclusion power—or, when they are asymmetric, the degree of inter-group asymmetry in exclusion power is relatively moderate—, then no population group gains from supporting tolerance of social exclusion. Only in societies where the inter-group asymmetry in exclusion power is sufficiently large, would the more powerful group gain from supporting tolerance of social exclusion. The analysis therefore suggests that democratization in socially heterogeneous countries, with relatively low level of population group asymmetry in exclusion power,

can be sufficient to eliminate social exclusion or marginalization. However, in societies where such asymmetry is sufficiently large, the introduction of democratic voting may not be sufficient. In that context, a necessary and sufficient condition for social exclusion to be eliminated is that the introduction of democratic voting be combined with an appropriately designed immigration policy that reduces the relative exclusion power of the majority group.

There is an extensive economics literature focusing on the effects of social heterogeneity on the basis of race [e.g., Alberto Alesina, Reza Baqir and William Easterly (1999)], ethnicity and religion [e.g., William Easterly and Ross Levine (1997); Mark Gradstein and Moshe Justman (2002); Mark Gradstein (2003); Jose G. Montalvoa, and Marta Reynal-Querol (2005)]. Alesina, Baqir and Easterly (1999) show that racial heterogeneity has a negative effect on the provision of public goods in the United States. Easterly and Levine (1999) show that ethnic divisions have a negative impact on the economic growth of African countries, because of their association with low educational attainments. Gradstein and Justman (2002) find that decentralized and segregated education in which different population groups [3] separately run uncoordinated school systems has a negative effect on growth. In an empirical study of ethnolinguistic diversity, Montalvoa and Reynal-Querol (2005) argue that ethnic (religious) polarization has a large, negative, effect on economic development, because it reduces investment while increasing government consumption and the probability of a civil conflict.

The common point of contributions in the above literature is that they all focus on the effects of social marginalization, and not on its political determinants. A notable exception is Mark Gradstein (2003) and most recently Mark Gradstein and Maurice Schiff (2006). Gradstein (2003) studies the political determinants of social exclusion in the case of multiple groups differentiated by race, religion, or ethnicity. He finds that in the presence of within-group human capital spillovers, social exclusion may win the majority's support.

It is important to note that in Mark Gradstein (2003), households do not explicitly have the option to supplement public education resources with private resources, so that

[3] In their case, ethnicity and religion are candidate sources of population heterogeneity.

if parental altruism is sufficiently high, the benefits of exclusion—which include human capital spillovers between members of the majority—will always outweigh its costs. In our model, social exclusion can obtain as a political outcome despite the absence of human capital spillovers, as long as investment in a child's human capital has both a public as well as a private component—which is empirically well documented [e.g Kremer and Chen (1999)]. Therefore, while Gradstein (2003) emphasizes the presence of within-group human capital externalities as an essential determinant of political support for social exclusion in a democracy, we, in contrast, emphasize the trade off between the cost of excluding rival population groups and household private investment in offspring's human capital formation. The distinguishing feature of our model is that each household has the option to supplement public education resources with a private investment in his offspring human capital. This feature of our model formalizes the degree of inter-group asymmetry in exclusion power (as measured, for example, by the degree of asymmetry in population size) as an important determining factor of the positive association between democratic voting and political support for social exclusion. Indeed, for each population group, the per capita cost of exclusion is increasing in the relative size of the rival group. We show that in that environment, social exclusion can still obtain as a political outcome.

Our research is more closely related to a recently published work by Mark Gradstein and Maurice Schiff (2006). Gradstein and Schiff (2006) build a model in which exclusion of the minority is the preferred strategy for the majority, and study conditions under which society can gradually progress towards social inclusion of the minority. Two main features distinguish our model from Gradstein and Schiff (2006). First, in their model only members of the minority, excluded from sharing in on publicly financed education resources, privately invest in their offspring's human capital formation. This implies that for the majority, public education completely crowds out parental private contribution to a child's human capital formation. We relax this assumption in our model. Indeed, in our model, both the majority and the minority have the option to supplement public education with private investment in their offspring's human capital formation. Relaxing this assumption allows us to endogenize the threat of rebellion or

secession by the minority.

Second, in Gradstein and Schiff (2006), the credibility of threat of rebellion by the minority is exogenously given. When this threat is sufficiently credible, the majority withdraws its support for social exclusion, and inclusion of the minority takes place. Only when this threat is incredible can social exclusion obtain and persist as a political outcome. In Gradstein and Schiff (2006), and perhaps deliberately so, no explicit consideration is given to the determinants of the credibility of this threat. Suppose as in Gradstein and Schiff that the minority can threaten to secede if their offspring are not included in the public allocation of education resources. On one hand, one would expect the minority to take a collective action aimed at establishing the credibility of their threat of secession. For example, they can expend their own resources in order to gain international legitimacy for their secession project; or they may invest in gathering legal resources necessary to justify their right to self-determination.[4] This, in turn, will raise the credibility of their threat of secession in the eyes of the majority group. On the other hand, anticipating such action by the minority, the majority group may, in response, undertake a collective action aimed at undermining the legitimacy of the minority's secession project. They may, for example, finance diplomatic missions abroad aimed at exposing the flaws of the minority's secession project, which, in turn, may reduce the threat of secession by the minority. This action and reaction process is best described, as we show in this chapter, as a non-cooperative secession or rebellion game. Exclusion of the minority will then obtain political support only if the majority has enough resources to undermine the credibility of rebellion or secession by the minority. Otherwise, social inclusion will take place. Unlike in Gradstein and Schiff (2006), therefore, our model uncovers the determinants of the credibility of the minority's threat of secession. We model the economic gains from supporting social exclusion as the level of welfare attained by an individual living in a society that has a degree, δ, of tolerance for social exclusion. We show that whether or not the majority gains economically by excluding the minority depends upon the extent of the majority's exclusion power–

[4]This may include exposing internationally the human injustice or exploitation they face in the larger multi-ethnic, or multi-religious state.

including its ability to undermine the threat of rebellion by the minority. To the extent that population size is, at least initially, the only source of asymmetry between rival groups, our analysis suggests that the introduction of democratic voting may not be sufficient to save small, but visible, minorities from social exclusion. This is because for very small minorities, the threat of secession or rebellion is not credible.

The remainder of this chapter is structured as follows. Section 2 presents the model. This model is solved in section 3. Finally section 4 provides concluding remarks.

2.2 Model

Consider an economy in which individuals differ primarily with respect to their ethnicity, or race, or religion. The economy lasts for two periods. Households in this economy are each composed of an altruistic parent and a single child, who makes no decision. Households are divided into N population groups, indexed by j, where $j = 1, ..., N$, ($N \geq 2$). We denote as $n_j \in (0,1)$ the relative size of population group j, with $n_1 + n_2 + ... + n_N = 1$.

To keep the focus on social heterogeneity on the basis of either ethnicity, race, or religion, assume agents are homogeneous within each population group. We denote as h_j^1, the human capital level of an adult member of population group j. We take this human capital level as a proxy for her labor income. A child's only activity is to accumulate human capital, the level of which depends on the quality of education received. Investment in child's education has two sources: a private source and a public source. The level of parental investment in child's education is denoted as e_{ij}, while the level of public investment in a child's human capital is denoted as θ_{ij}. Thus, the human capital level of a child whose parent i ($i \in [0, n_j]$) belongs to population group j is given by:

$$h_{ij}^2 = De_{ij} + \theta_{ij}, \qquad D \in (0,1) \tag{2.1}$$

where D denotes the exogenously given relative productivity of parental investment in child's education.[5] Observe that since public investment in education substitutes for

[5]The assumption of perfect substitution between the private and the public component of human

parental investment, such investment will not be socially desirable unless $D < 1$, i.e., the productivity of parental investment in child's education is lower than that of public investment in education. We motivate public investment in this environment by the assumption that $D \in (0,1)$, so that public investment in education has the potential to enhance economic growth.[6]

Public funds, θ, allocated to public investment in education are financed by an exogenously given income tax levied on all parents, at a proportional rate $t \in [0,1)$. Assuming balanced government budget, the level of public funds allocated to public investment in education is given by

$$\theta = t\sum_{j=1}^{N} n_j h_j^1 \equiv t\bar{h}^1. \tag{2.2}$$

Again to keep the focus on social exclusion of rival population groups, let us normalize household consumption to 0, so that each household's essential decision is restricted to investment in child education, so as to maximize the child's human capital. Assume population groups compete against one another for a larger share of public investment in education. Thus, following Mark Gradstein (2003), each population group j expends an amount x_j to finance a group-specific collective effort to exclude rival population groups from, or including members of the group in, the allocation of public education resources.[7] We denote as

$$\alpha_j = \frac{(x_j)^\delta n_j}{R}, \tag{2.3}$$

the share of these resources secured by members of population group j, when, as a

capital investment is made without loss of generality. Imperfect substitution (*a la* Cobb Douglas) further complicates the exposition without any new qualitative insight. Furthermore, the assumption of perfect substitution between human capital inputs is not restricted to our analysis. A similar assumption is made by Gary S Becker, Kevin Murphy, and Robert Tamura [1990].

[6]This assumption is particularly relevant when one includes respect for the rule of law and for national institutions as a constituent of human capital. Marc Gradstein and Moshe Justman [2002] argue that public investment in education is better than private investment in enhancing the accumulation of these important constituents of individual human capital.

[7]In the case of a majority group (M) and a minority group (m), one can think of x_m for example, as resource expended by the minority in order to increase the credibility of their of rebellion if they are excluded by the majority. And one can think of x_M as the level of resource expended by the majority in order to undermine the credibility of the minority's threat of rebellion.

group, they allocate an amount x_j to exclude their rivals from the allocation of publicly provided education resources, where $\delta \in [0,1]$ is an endogenous measure of the degree of competition between population groups comprising the society and

$$R = \sum_{j=1}^{N} (x_j)^{\delta} n_j. \tag{2.4}$$

As in Esteban and Ray [1999], R is interpreted here as a measure of the intensity of the inter-ethnic competition for public educational resources. Given α_j, the share of total public resources secured by population group j for its members' use is

$$\theta_j = \alpha_j \theta, \tag{2.5}$$

so that public education resources received by a child i born of a parent who belongs to population group j are given by

$$\theta_{ij} = \frac{\alpha_j \theta}{n_j}, \tag{2.6}$$

all $i \in [0, n_j]$, and all j $(j = 1, ..., N)$. In a society where population groups are segregated, for example, by place of residence, the share, θ_{ij}, may be interpreted as the relative quality of public schools attended by children whose parents belong to population group j.

Assume no free-riding within members of the same population group, so that total lobbying expenditures by ethnic group j are equally shared by all group members. Thus, the budget constraint faced by the representative member of population group j is given by the following inequality:

$$e_{ij} + (n_j)^{-1} x_j \leq (1-t)\, h_j^1, \tag{2.7}$$

all i and all j.

Given the amount, $(n_j)^{-1} x_j$, contributed to collective action by population group j to exclude rival groups from sharing in on publicly provided education resources, the

objective of each parent i, member of population group j, is to choose e_{ij} so as to solve the following problem:

$$\max_{e_{ij}} h_{ij}^2$$

subject to (2.1), (2.6), and (2.7). Since parents are homogeneous within each population group j, it is clear that they will all choose the same level of parental investment in child's education, so that $e_{ij} = e_j$, all i. Therefore, since a child's human capital level is strictly increasing in the amount of public education resources received, clearly the budget constraint will be satisfied with equality. Consequently, for each population group j, participation in the exclusion contest is characterized by the following equation

$$x_j = (1-t)\, n_j h_j^1 - e_j n_j, \tag{2.8}$$

all j. Hence the trade off in each child's human capital between the cost, x_j, of excluding rival population groups' children and parental investment in own offspring's human capital. Thus, the representative parent's choice of e_j determines the extent to which population group j participates in the exclusion contest. We characterize the determinants of this participation below.

2.3 Winners and Losers in the Exclusion Contest

In this subsection we characterize the exclusion contest involving the representative members of each of the N population groups comprising the society. Since there is no free-riding between same-group individuals, the exclusion contest will essentially pit the representative members of each of the population groups comprising the society. In what follows, we study the outcome of this contest as a Nash-equilibrium of a non-cooperative game between the respective representative members.

Denote as player j, the representative member of population group j (with $j = 1, ...N$). Let $E_j \subset \Re_+$, denotes the strategy set of player j, with generic element e_j. Let $E \equiv E_1 \times E_2 \times ..... \times E_N$ denotes the space of all feasible strategy profiles, with generic element e. Define a real-valued function $V^j : E \to \Re$ by $w_j = V^j(e)$, where

w_j denotes the payoff to player j when the strategy profile $e = (e_j, e_{-j})$ is played, and e_{-j} denotes the strategy profile chosen by the aggregate all players other than player j. From equation (2.1), substituting in (2.3)-(2.6), and (2.8), rearranging terms, yields player j's payoff function as follows:

$$V^j(e_j) = De_j + \frac{(w_j - e_j)^\delta (n_j)^{1+\delta}}{\sum_{l=1}^{N} (w_l - e_l)^\delta (n_l)^{1+\delta}} \frac{\theta}{n_j}, \tag{2.9}$$

all j, where

$$w_j = (1-t)\, h_j^1, \tag{2.10}$$

and θ is as defined in (2.2). Given e_{-j}, player $j's$ best response satisfies the following equation

$$D = (w_j - e_j)^{\delta-1} (n_j)^{1+\delta} \frac{\sum_{l \neq j} (w_j - e_l)^\delta (n_l)^{1+\delta}}{\left[\sum_{l=1}^{N} (w_j - e_l)^\delta (n_l)^{1+\delta}\right]^2} \frac{\delta\theta}{n_j}. \tag{2.11}$$

To solve for the Nash equilibria of this game, we consider two cases: a benchmark case where all population groups are symmetric and another one where this assumption is relaxed.

2.3.1 Exclusion Contest with Symmetric Exclusion Power

In this subsection, we begin by characterizing the growth effect of social exclusion by solving a benchmark model where all population groups have equal size (i.e., $n_j = n$ all j) and equal initial wealth (i.e., $h_j^1 = h^1$, all j). This implies that all population groups have identical exclusion power. We then investigate, in that context, whether democratic voting can generate social exclusion on the basis of ethnicity as a political outcome. The assumption of ethnic symmetry allows us to take full advantage of the computational simplicity of symmetric non-cooperative games. Hence the following proposition:

Proposition 2.1: *Suppose $n_j = n$ and $h_j^1 = h^1$, all j. Then, the Nash-equilibrium*

profile, $e^* = (e_1^*, ..., e_N^*)$, *is given by*

$$e_j^* = \left[(1-t) - \frac{(N-1)\,\delta}{DN} t\right] h^1,$$

all j.

Proof: A symmetric Nash equilibrium is one where $e_j = e_l$, all $l \neq j$. From (2.11), substituting $e_j = e_l$ rearranging terms, we can rewrite the first order condition as follows:

$$D = \frac{(N-1)\,\delta\theta}{N\left[(1-t)\,h^1 - e_j\right]},$$

where $\theta = th^1$. Hence the result. ■

As an implication of the above proposition, the equilibrium income of a child when adult can be rewritten as follows:

$$h_j^2 = (1-t)\,Dh^1 + \left[\frac{N-(N-1)\,\delta}{N}\right] th^1,$$

all j. Let $\bar{h}^\tau = \sum_{j=1}^{N} n_j h_j^\tau$ denotes the $\tau-$ generation's average wealth level, $\tau \in \{1,2\}$. Using the assumption of population group symmetry, the gross rate of economic growth in this economy with social exclusion is thus given by

$$g = \frac{\bar{h}^2}{\bar{h}^1} = (1-t)\,D + \left[\frac{N-(N-1)\,\delta}{N}\right] t \tag{2.12}$$

since, by symmetry, $\bar{h}^\tau = h^\tau$ all $\tau = 1, 2$.

A number of observations can be derived from the growth rate expression (2.12). First, social heterogeneity (i.e., $N > 1$) has a negative effect on the economic growth of a society that tolerates social exclusion (i.e., a society where $\delta > 0$). Hence the following proposition:

Proposition 2.2: *Suppose* $n_j = n$ *and* $h_j^1 = h^1$, *all* j. *Then, in an ethnically diverse economy (i.e.,* $N > 1$*), growth is smaller, the higher the degree,* δ*, of society's tolerance for social exclusion.*

Second, if δ is sufficiently high, then an increase in the level of the tax rate financing

public investment in education can actually reduce the growth rate of the economy. Hence the following proposition:

Proposition 2.3: *Let $n_j = n$ and $h_j^1 = h^1$, all j, and suppose the triplet (δ, D, N) satisfies*

$$\frac{(1-D)N}{N-1} < \delta \leq 1, \tag{2.13}$$

then, public investment in education hinders economic growth.

Proof: It suffices to show that

$$\frac{\partial g}{\partial t} < 0,$$

whenever condition (2.13) holds. This result is obtained by simply differentiating expression (2.12) with respect to t. ■

Since $D \in (0,1)$, condition (2.13) can easily obtain in sufficiently heterogeneous societies. In particular, as $N \to \infty$, this condition converges to $1 - D < \delta \leq 1$, with $D \in (0,1)$. The result in Proposition 2.3 reflects the substitutability between public and private investment in a child's human capital. The results of propositions 2.2 and 2.3 together suggest that tolerating social exclusion can be costly to a society. First, tolerance of social exclusion slows down growth (Proposition 2.2). Second, if such tolerance is sufficiently high, it can even cause public investment in education to become unproductive in a society with a high degree of heterogeneity (Proposition 2.3). If so, why would ethnically diverse societies tolerate it ?

Observe that in this benchmark economy studied above, the equilibrium payoff to participating in the exclusion contest is identical across population groups, and given by

$$\bar{V}^j(\delta) = (1-t)Dh^1 + \left[\frac{N-(N-1)\delta}{N}\right] th^1$$

all j. Therefore, in a political equilibrium with democratic voting over the level of δ, it is clear that social exclusion will be rejected in favor of social cohesion, since for all j,

$$0 = \arg\max_{\delta} \bar{V}^j(\delta).$$

In this benchmark case, all population groups understand that there will be no winner in the exclusion contest, as in a democracy they all have equal lobbying strength reflected by equal size and equal economic power. In what follows, we ask whether these results extent to the case of asymmetric population groups.

2.3.2 Asymmetry in Exclusion Power

In this subsection, we relax the assumption of symmetry in exclusion power as captured by the group size, and attempt to solve for Nash-equilibria of the social exclusion game. The goal of this exercise is to identify the sources (if any) of political tolerance for social exclusion. In the interest of simplicity we restrict attention to two population groups, denoted group M (i.e., the majority group) and group m (i.e., the minority), respectively, with $n_m < n_M$. In other words, $N = 2$. For simplicity, we let $h^1 = h^j$, all j, so that differences in group size also captures difference in lobbying power. In that context, using (2.9), it can be shown that a Nash-equilibrium profile satisfies the following system of two equations in two unknown (e_m, e_M)

$$m \;:\; \frac{(w-e_m)^{\delta}(n_m)^{1+\delta}(w-e_M)^{\delta}(n_M)^{1+\delta}}{\left[(w-e_m)^{\delta}(n_m)^{1+\delta}+(w-e_M)^{\delta}(n_M)^{1+\delta}\right]^2}\frac{\delta\theta}{D} = (w-e_m)\,n_m \qquad (2.14)$$

$$M \;:\; \frac{(w-e_m)^{\delta}(n_m)^{1+\delta}(w-e_M)^{\delta}(n_M)^{1+\delta}}{\left[(w-e_m)^{\delta}(n_m)^{1+\delta}+(w-e_M)^{\delta}(n_M)^{1+\delta}\right]^2}\frac{\delta\theta}{D} = (w-e_M)\,n_M \qquad (2.15)$$

where w is as defined in (2.10), θ is as defined in (2.2), and $n_m + n_M = 1$. Combining the above first order conditions yields the following arbitrage condition:

$$(w-e_m)\,n_m = (w-e_M)\,n_M. \qquad (2.16)$$

Observe that a direct implication of *Eq.* (2.16) is that as long as population groups have different sizes, i.e. $n_m \neq n_M$, all Nash-equilibria are asymmetric in players' strategies: $e_j \neq e_{-j}$, all j. hence the following Lemma:

Lemma 2.1 *The unique Nash-equilibrium of this exclusion game is given by*

$$e_j^* = w - n_{-j}\delta\theta/D, \tag{2.17}$$

for all $j = m, M$.

Proof: Equation (2.16) implies that

$$(w - e_m) = (w - e_M)\frac{n_M}{n_m}.$$

Substituting this back into (2.15), rearranging terms then yields the result. ■

Consider expression (2.8). Substituting in (2.17) yields, for a typical member of population group j, her per capita investment, $\varkappa_j^* = x_j^*/n_j$, in the exclusion contest as follows:

$$\varkappa_j^* = n_{-j}\delta\theta/D. \tag{2.18}$$

Then, observe that in comparison to the ethnic majority, members of the ethnic minority invest more resources per capita in the exclusion contest:

$$\varkappa_m^* > \varkappa_M^*,$$

due to the asymmetry in exclusion power (i.e., $n_M > n_m$). In other words, to avoid being totally excluded from the allocation of public education resources, members of the ethnic minority must allocate relatively more resources per capita in the exclusion contest. As a result, they end up each diverting more resources away from private investment in their offspring's human capital:

$$e_m^* < e_M^*.$$

This result is a direct implication of the power asymmetry (i.e., $n_M > n_m$) between the two population groups comprising the society. We have just proved the following Proposition:

Proposition 2.4: *Tolerance of social exclusion in a context of population group asymmetry in exclusion power forces members of the ethnic minority to waste relatively more resources, at the expense of their offspring's human capital.*

How wasteful tolerance of social exclusion will force members of the ethnic minority to be, depends on the extent of the asymmetry in exclusion power between the two population groups. We distinguish two cases: (i) $n_M < wD/\delta\theta$; (ii) $n_M \geqslant wD/\delta\theta$. In the first case, the asymmetry in exclusion power is moderate, in the sense that each member of the minority group can still privately invest in his offspring's education despite participation in the exclusion contest: $e_m > 0$. In the second case, the asymmetry in exclusion power is sufficiently large, in the sense that participation in the exclusion contest precludes private investment in education for members of ethnic minority: $e_m = 0$.

Case 1: $n_M < wD/\delta\theta$

In this subsection, we address the issue of who gains from supporting social exclusion when the inter-group asymmetry in exclusion power is not too large: $n_M < wD/\delta\theta$. We first characterize population groups' equilibrium payoffs from participating in the exclusion contest.

Lemma 2.2: *Let $h_M^1 = h_m^1$. Suppose $n_M < wD/\delta\theta$. Then, the equilibrium payoff accrued to the representative member of ethnic j is given by:*

$$\hat{V}^j(\delta) = Dw + [1 - n_{-j}\delta]\,\theta, \tag{2.19}$$

all $j = m, M$.

Proof: Under the condition $n_M < wD/\delta\theta$, it can be shown that both population groups invest privately in their offspring's education in order to supplement publicly provided education resources. Thus, from (2.9) substituting in (2.17), rearranging terms yields the result. ■

A number of observations can be derived from *Eq.* (2.19). First, the majority group is the contest winner:

$$\text{for all } \delta, \qquad \hat{V}^M(\delta) > \hat{V}^m(\delta).$$

The second observation is summarized by the following proposition.

Proposition 2.5: *Suppose* $n_m < n_M < wD/\delta\theta$. *Then neither the minority group nor the majority benefit from supporting tolerance for social exclusion.*

Proof: It suffices to show that for all $j = m, M$,

$$0 = \arg\max_{\delta} \hat{V}^j(\delta).$$

This can be done by observing from (2.19) that the function $\hat{V}^j(.)$ is strictly decreasing for all $j = m, M$. Hence the result. ■

That this result hold for the ethnic minority is straightforward because tolerance of social exclusion causes members of that group to become relatively more resource-wasteful, which, by backward induction, leads them to propose a zero-tolerance policy for this phenomenon. For this result to hold for the contest winner as well, is less straightforward. Yet the reason the majority group also rejects social exclusion is quite intuitive. Excluding the minority group from sharing in on public resources entails both costs (wasted resources) and benefits measured by the share of resources captured by the group. When the inter-group asymmetry is moderate in the sense that $n_M < wD/\delta\theta$, this reduces the benefit the majority derives from excluding the minority from the allocation of public education resources. As a result, the costs of excluding the ethnic minority continue to outweigh the benefit of doing so, hence their lack of support for social exclusion. The above Proposition implies that in societies where the inter-group asymmetry in exclusion power is moderate enough, the presence of social exclusion may reflect the absence of democracy.

Case 2: $n_M \geq wD/\delta\theta > n_m$

In this subsection, we revisit the issue of who gains from supporting social exclusion in the case where the inter-group asymmetry in exclusion power is relatively large: $n_M \geq wD/\delta\theta$. In that case, the asymmetry in exclusion power is such that participating in the exclusion contest forces the minority group to give up on supplementing public resources with private investment in child's human capital. In other words, $e_m = 0$, while $e_M > 0$. We begin with the following lemma.

Lemma 2.3: *Let* $h_M^1 = h_m^1$. *Suppose*

$$n_M \geq wD/\delta\theta > n_m. \tag{2.20}$$

Then, the equilibrium payoff accrued to each member of ethnic group j *is given by:*

$$V^{*j}(\delta) = \begin{cases} \theta/\left[n_m + \phi(\delta) n_M\right] & \text{for } j = m \\ Dw + \psi(\delta)\theta \text{for } j = M \end{cases}, \tag{2.21}$$

where

$$\phi(\delta) = \left[\frac{\delta t n_M}{(1-t)D}\right]^{\delta}, \tag{2.22}$$

$$\psi(\delta) = \frac{1}{n_M + [\phi(\delta)]^{-1} n_m} - n_m\delta. \tag{2.23}$$

Proof: The result simply follows from substituting expressions (2.17) into (2.9), using condition (2.20), and rearranging terms. ■

Expression (2.21) characterizes each population group's payoff from living in a society that has a degree, δ, of tolerance for social exclusion. In order to understand who gains and who loses from supporting social exclusion, we again ask each individual to make a proposal on the level that δ should take in the society. Our results are summarized by the following Proposition:

Proposition 2.6: *Let* $h_M^1 = h_m^1$. *Suppose* $n_M \geq wD/\delta\theta > n_m$. *Then, only the majority group gains from supporting social exclusion.*

Proof: It suffices to show that the function $V^{*m}(.)$ is strictly decreasing in δ, while $V^{*M}(.)$ is strictly increasing in δ. ■

Claim 1: *$V^{*m}(.)$ is a strictly decreasing function.*

Proof of Claim 1: To show that $V^{*m}(.)$ is a strictly decreasing function, it suffices to show that $\phi(.)$ is a strictly increasing function, i.e., $\phi'(\delta) > 0$. To see this, let $\varphi(\delta) = \log \phi(\delta)$,where $\phi(\delta)$ is as defined in (2.22). Then, it can be shown that

$$\varphi'(\delta) = 1 + \log\left[\frac{\delta t n_M}{(1-t)D}\right] > 0, \text{ since } n_M \geq wD/\delta\theta.$$

Hence $\phi'(\delta) = \varphi'(\delta)\phi(\delta) > 0$. This completes the proof. ■

Claim 2: *$V^{*M}(.)$ is a strictly increasing function.*

Proof of Claim 2: The proof follows in two steps. First, we establish analytically that $V^{*M}(.)$ is at least non-decreasing in δ. Then we show numerically that $V^{*M}(.)$ is indeed strictly increasing in δ.[8]

Differentiate (2.23) with respect to δ to get

$$\psi'(\delta) = \frac{\phi'(\delta) n_m}{[\phi(\delta) n_M + n_m]^2} - n_m.$$

Next, to show that $\psi'(\delta) > 0$, it suffices to establish that

$$\phi'(\delta) \geq [\phi(\delta) n_M + n_m]^2.$$

Since by construction $\phi'(\delta) = \varphi'(\delta)\phi(\delta)$, the above inequality reduces to

$$\left[1 + \frac{1}{\delta}\log\phi(\delta)\right]\phi(\delta) \geq [\phi(\delta) n_M + n_m]^2. \tag{2.24}$$

Now, suppose by way of contradiction that inequality (2.24) does not hold for $n_M \geq wD/\delta\theta$. Then, observe that as $n_M \to wD/\delta\theta$, it is clear that $\phi(\delta) \to 1$, so that

[8]The fact that the payoff function can be increasing for some reasonable values of δ is enough to make our point since this shows that there are situations where the majority group is better off if the society's tolerance for social exclusion is high. One would therefore expect this group to vote for a high δ-society .

$[\phi(\delta) n_M + n_m]^2 \to 1$, since $n_M + n_m = 1$, and

$$\left[1 + \frac{1}{\delta} \log \phi(\delta)\right] \phi(\delta) \to 1,$$

which is clearly a contradiction.

Next, we solve two numerical examples to illustrate that $V(.)$ is strictly increasing in δ.

In Figure 2-a at the end of this chapter, the tax rate is chosen at $t = .15$, which set $n_M = .90$, in order for condition (2.20) to be satisfied. In Figure 2-b, the tax rate is raised at $t = .20$, which set $n_M = .75$ in order for condition (2.20) to hold. In both cases, the value function $V^{*M}(.)$ is strictly increasing for values of δ chosen in the interval $[.65, 1]$. Values of $\delta < .65$ are inconsistent with condition (2.20). Hence the result. ■

Condition (2.20) states that the majority group's relative population size is sufficiently large. It implies that for the majority population group, the benefits of excluding the rival group exceed its costs, while the reverse is true for the minority group. As a result, only the former gains from supporting society's tolerance for social exclusion. In such a society, therefore, one would expect political candidates to have ethnic, religious or racial-based constituencies, and social exclusion will thrive under democratic voting. Our analysis replicates Gradstein's (2003) result only in cases where inter-group asymmetry in exclusion power is sufficiently large. So when population groups have equal size, or when the asymmetry in sizes is not too large, democratic voting can eliminate social exclusion on the basis of ethnicity, religion, or race. This is because in that case, all population groups anticipate that the intensity of exclusion contest will be too high, so that the costs of excluding rival population groups will exceed its benefits. However, when the inter-group size asymmetry is sufficiently large, then democratic voting can yield political support for social exclusion. This is because for members of the majority, the per capita cost of excluding the minority group is smaller, the smaller the relative population size of the minority. In order words, the higher (respectively, the smaller) the size of the majority (respectively, the minority), the more able (respectively, less able) will each of its members be to supplement public investment by private investment.

For members of the majority, this will raise the benefits of exclusion, while lowering its costs. Hence the majority's political support for society's tolerance of social exclusion, in a democratic environment.

2.4 Concluding Remarks

This essay seeks to contribute to the understanding of the political determinants of societies tolerance for social exclusion on the basis of ethnicity, religion, or race. We developed a political-economic model where society's degree of tolerance for social exclusion obtains as a political equilibrium under democratic voting. Echoing the existing economics literature on the effects of social exclusion, we find that indeed social exclusion is harmful to growth. On the issue of whether democratic voting can support the emergence of social exclusion as a political equilibrium, we find two types of answers depending on the context. More specifically, we find that in a context where ethnic, religious, or racial groups are either symmetric in exclusion power—or, when they are asymmetric, the degree of inter-group asymmetry in exclusion power is relatively moderate—, then no group gains from supporting tolerance of social exclusion. Only in societies where the inter-group asymmetry in exclusion power is sufficiently large, would the more powerful group gain from supporting tolerance of social exclusion. Our analysis therefore suggests that while democratic voting in ethnically diverse societies with relatively low level of population group asymmetry in exclusion power can be sufficient to eliminate social exclusion, it may, in contrast, actually generate social exclusion as a political outcome in societies where the inter-group asymmetry in exclusion power is sufficiently large.

Another important result of this chapter is that the majority's political support for social exclusion is increasing in its exclusion power. This exclusion power, in turn, is determined by the relative size of the minority, as the latter affects the cost to the majority of excluding the minority. Our analysis therefore suggests that an immigration policy aimed at reducing the majority's exclusion power combines with the introduction of democratic voting to represent an effective weapon against social exclusion.

These results where obtained in a framework where investment in child's human capital has two perfectly substitutable components: a private component controlled by the parent and a public component controlled by a government endowed with the power of taxation. This double sourcing of human capital inputs was the distinguishing feature of our model. With respect to Mark Gradstein (2003), this double sourcing allowed us to obtain persistence of social exclusion without appealing to within group human capital spillovers. With respect to Mark Gradstein and Maurice Schiff (2006), this double sourcing allowed us to endogenize the credibility of the threat of rebellion by the minority. Because of our focus on endogenizing the costs and benefits of social exclusion, we restricted attention to a case where the exclusion power of the majority is determined solely by its size. Consideration of income or wealth asymmetry either as an alternative source of exclusion power or as an important component of that power, in our opinion, would add no new qualitative insights to the analysis.

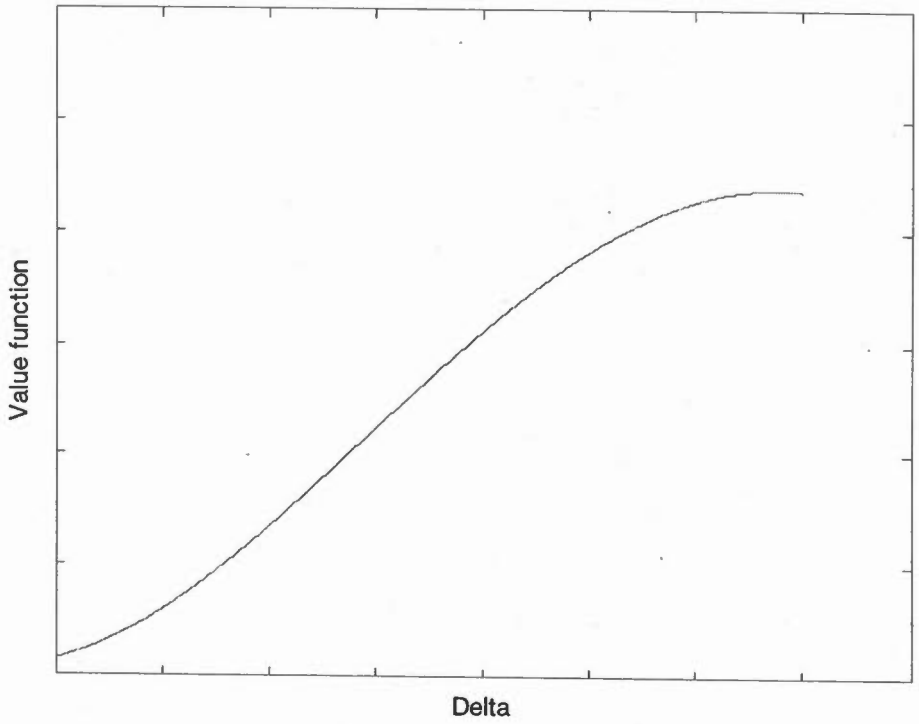

Figure 2.a

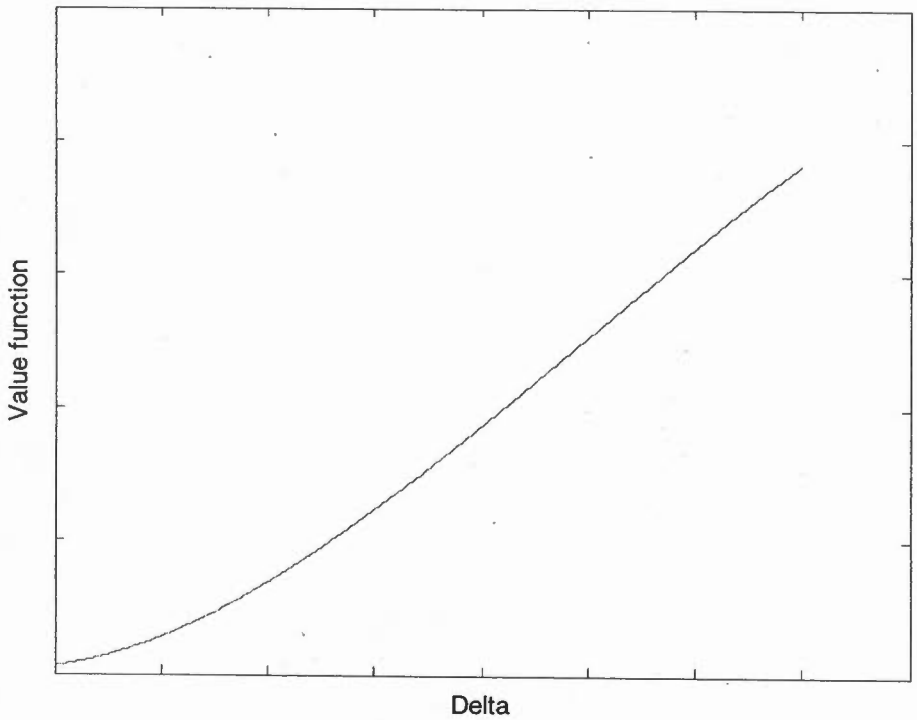

Figure 2.b

Chapter 3

The Economics of Child Trafficking

ABSTRACT[1]

The trafficking of children is a thriving business. In this chapter, we highlight key economic characteristics of this business. We show that the fight against child trafficking is far from trivial and that supply-side policies have very limited effect unless preceded by attacks on the demand side. Successful policies involve international cooperation on both fronts. We work within a model of a source country to highlight the necessary ingredients of a successful international cooperation towards the elimination of child trafficking.

3.1 Introduction

The trafficking of children is a thriving business.[2] According to the International Labor Organization (ILO), in 2002, more than 1.2 million children were trafficked in the world (ILO-IPEC- 2002). One would think that a business of such scale should be easy to regulate. The fight against child trafficking, however, is far from trivial. To succeed in this fight, it is crucial to understand some important aspects of the business at hand.

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[1] Co-written with Stephane Pallage and Sylvain Dessy

[2] The *United Nations' 2000 Protocol to Prevent, Suppress and Punish Trafficking in Persons* defines child trafficking as ``the recruitment, transportation, transfer, harboring or receipt of persons, by means of threat or use of force or other forms of coercion, of abduction, of fraud, of deception, of abuse of power or of a position of vulnerability or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person, for the purpose of exploitation."

Children are trafficked away for several purposes. Some end up working as modern slaves in plantations or factories, some wind up on the sex market, some others find themselves as child soldiers on the frontline of a conflict foreign to them. There may be several market segments, depending on the purpose, but they all share key economic characteristics.

First, and foremost, each market is an international market with an international price. Well-meaning individual efforts by some governments may thus not be very meaningful in the end. Worse, as we show in this chapter, such individual efforts may be counter-productive for the global fight against child trafficking. Second, the trafficking of children obeys the laws of supply and demand. A rise in the price of children attracts new traffickers on the market, while a drop in the price makes children affordable to a wider audience. Third, traffickers prey on children who are most vulnerable, either because parental supervision is lacking or because parents are excessively credulous, to the point of confiding their children to the care of well-speaking strangers. There are two ways of protecting children. On the one hand, parents may invest time and energy in the supervision of their children. On the other hand, governments may invest in the education of parents or in public protection mechanisms to supplement parental supervision. Both types of protections entail a cost. Fourth, this cost of protecting children is an increasing function of the number of traffickers. Fifth, the success of traffickers is a decreasing function of the private and public investments in the protection of children. Last but not least, child traffickers operate in well organized rings and follow a basic standard in organized crime: competition is bad for business. While there is not much evidence on the actual degree of competition between traffickers, tacit collusion is the only way such rings could have had the time to establish themselves and reach their level of proficiency. Their trade is well functioning, so well indeed that traffickers, for example, rarely smuggle children across borders: they are often equipped with false passports and the tools to bribe officials when needed. The rings need not be large but they involve at least a few people in different countries (see Dottridge, 2004 for an excellent description of the trade).[3]

[3]While the characteristics of this business apply to human trafficking markets in general, we focus

An understanding of those principles leads to the following important remarks. Ceteris paribus, if a country invests in the protection of its children and succeeds in the fight of traffickers at home, this tends to drive the international price of children upward, which is likely to make it more costly for other countries to provide similar protection for their children. One's efforts to fight trafficking in one's own backyard *de facto* exert a negative externality on the rest of the world. Clearly, rich countries have taken the lead in the protection of their children, which has strong implications on the structure of the market: It implies that most of the supply originates from poor countries, but also that most of the demand originates from individuals of richer countries. Indeed, by making it more costly for poor countries to protect their children, it makes poor children even more vulnerable to traffickers. By establishing the market price at a relatively high level, it also makes children a commodity affordable primarily to the wealthy. This polarization of the market can be explained at least partly by the leading role rich countries have assumed in the ILO-IPEC crusade against trafficking.

Child trafficking therefore appears to be very hard to combat. A winning strategy would imply a move from mere myopic supply-side policies to a more complex policy intervention. The first step would involve a simultaneous, coordinated attack by all destination countries on the demand side of the market. The second step would require a similar coordination on the supply-side. The first step, however, is not easy to achieve. Because the demand originates from richer countries who have secured the protection of their children by supply-side policies, a significant part of the responsibility for the elimination of child trafficking lies in the hands of the latter, while victims originate from poorer countries. The sense of altruism of rich countries will thus be put to the test.

Our purpose, in this chapter, is to emphasize the fundamental economics of child trafficking in a way that may help guide policy makers in this highly important matter.

on child trafficking because of the special vulnerability of children to traffickers.

3.1.1 The facts

International consensus — In most countries, human trafficking is acknowledged as a serious crime, punishable by law. Yet, owing to dramatic improvements in transportation and communication technologies, child trafficking has developed into a transnational crime, and appears to be on the rise worldwide. The ILO-IPEC (2001), the UNICEF (2002) and the US-state-department (20 03) have all pulled the alarm warning about its growing scope and its transnational complexity. The international community's response to the transnational nature of the phenomenon resulted in a series of international conventions: the United Nations' *Convention on the Rights of the Child* and its *Optional Protocol on the Sale of Children, Child Prostitution and Child Pornography*, and *Convention C182* by the ILO (1999). All efforts made so far to fight child trafficking are laudable. They typically stress the need for international cooperation. This chapter may help guide policy makers on the desirable form of such cooperation and sequence of policy action.

Some statistics — Trafficked children flow from poorer to richer countries. The UNICEF's international flow chart summarized in Table 3.1 indeed suggests that receiving countries are all wealthier on a per capita basis than source countries. In West and Central Africa, for example, children from Burkina Faso, Ghana, Mali and Togo are trafficked to the relatively richer Cameroon, Côte d'Ivoire, Gabon and Nigeria. In South Asia, Nepal acts as a source-country for India, with a per capita GDP of roughly twice that of Nepal. For this region, the *Committee on the Rights of the Child* reports that in 1995 an estimated 100,000 to 150,000 Nepalese girls and women had been trafficked into India for sexual exploitation. In South-East Asia, Thailand is reported to be the main receiving country, with an estimated 194,180 foreign child laborers reported in 1996, mostly from Cambodia, China (particularly from the Yunnan Province), Lao PDR, Myanmar and Vietnam, all of which are poorer relatively to Thailand. Clearly final users may not necessarily be from the receiving countries. Yet the flows indicate a relative polarization of the market.

As is also clear from Table 3.1 and Figure 3.a, the richest countries are important

destination countries. Examples include, Australia, Canada, Germany, Greece, Japan, the Netherlands, the United States. None of them is reported as a significant source country.

3.1.2 This chapter

This chapter develops a model in which the supply of trafficked children arises endogenously. In our model, children are kidnapped from a source-country, and illegally shipped into the rest of the world for profit. Children's protection from potential traffickers involves both the family – acting as a private protective unit through parental investment in child protection –, and a government, which allocates public expenditures to improve enforcement of laws against child trafficking. The supply of child trafficking emerges if and only if a positive fraction of the economy's entrepreneurs find it optimal to invest their capital in breaking down protective barriers against child trafficking set up by both families and the local government, given the state of the international demand for children.

We use this model to study the determinants of the ability of a source-country government, acting unilaterally, to curb the supply of trafficked children. We highlight the negative externality exerted by foreign countries' efforts to fight trafficking at home on our model economy, and the key role this externality plays on the polarization of the market observed in the data.

The starting point of our analysis is the observation that since by nature, children are most vulnerable when left unprotected, building a protective environment for these children requires both parental and public investments. Parents are usually called upon to provide for their children's basic needs, including nutrition, adequate clothing, health, and education, which may reduce the risk for these children of being lured by the false promises of better lives outside their home environment. However, for many reasons that include poverty, families often fail to be effective protective units for their children, thus making them the perfect victims for traffickers. To help protect children from traffickers, government officials may launch public awareness campaigns, in addition to

the recruiting, training, and equipping of customs officials, police officers, and other law-enforcers.

Notwithstanding the above, even well-intentioned government officials may fail to prevent children from being trafficked away if, when acting unilaterally, they are unable to affect the international price for trafficked children. The higher this price, the higher the return to creating a supply of trafficked children, which, in turn, may induce well-organized criminal groups to step up the effort to break down barriers against child trafficking. In other words, a high international price acts as a "ladder," helping well-organized criminal groups to climb up the protective walls set up by families and government officials. The critical law-enforcement effort is therefore one that raises the wall higher than the ladder. The higher the ladder, the higher the wall should be, and thus the more public funds will be needed.

The rest of the chapter is presented as follows. Section 2 offers a brief literature review. Section 3 presents the model and its solution. Section 4 concludes.

3.2 Literature review

The ILO classifies child trafficking as one of the worst forms of child labor, under Convention C182. Due to the outrageous nature of this phenomenon, an international consensus has developed on its elimination, often prompting policy actions, which, unfortunately, preceded research by many years. Swinnerton and Rogers (2005) and Dessy and Pallage (2005) are the first papers to attempt a theoretical exploration of the economics of this phenomenon.

Using a model of parental investment in child's education, Dessy and Pallage (2005), show that when a country is very poor, in order for a ban on the worst forms of child labor to bring a Pareto-improvement, appropriate mechanisms must be designed to mitigate the decline in child labor wages caused by a ban-induced reduction in employment options for children. Swinnerton and Rogers (2005) offer a counter-argument in a model exploring the welfare effects of banning exploitative forms of child labor. They argue that because the ban pushes both the exploited children and the exploiters towards

the non-exploitative side of the market, this has beneficial effects on child labor wages. They do not discuss, however, the determinants of a government's ability to enforce the ban on the worst forms of child labor. Yet enforcement is non trivial. While a ban has the potential to raise child labor wages in their model, it also has the adverse effect of depressing the return to capital, due to reduced market options. Capitalists may therefore have a vested interest in opposing such a ban Moehling (1999), or in bringing down barriers to child exploitation set up by law-enforcement. In Swinnerton and Rogers (2005), parents are passive and do not invest in child protection. Although parents in their model know that their children can fall victims to traffickers, they do not allocate household resources to reducing the probability that their child may be trafficked away. Parents in our model may do that.

By focusing on the microeconomics of both children's vulnerability to trafficking and capitalists' decision to supply trafficked children, our research seeks to explain the determinants of the critical level of public expenditures a government must allocate in order to stop child trafficking at the source. It also seeks to explain why poorer countries are more likely to be source-countries for child trafficking: since building a protective environment for children involves household investment, poverty may make households too dependent upon government officials for the protection of their children. In other words, poorer families may substitute public for private barriers against child trafficking. As a result, higher public funds are required in poorer than in richer countries in order to curb the supply of trafficked children. With economic development, in contrast, households become richer; this enables them to become more effective as protective units for their respective children, thus lessening their dependence upon the government to build barriers against child out-trafficking. In that case, the critical level of government effort is lower, which therefore reduces the level of public funds necessary to curb the supply.

If child exploitation or the worst forms of child labor have not been studied much, there exists, however, a large literature on child labor, both theoretical and empirical. The theoretical literature was initiated by the seminal work of Basu and Van (1998). Among the contributors are Basu (1999, 2000), Swinnerton and Rogers (1999), Baland

and Robinson (2000), Ranjan (1999, 2001), Dessy (2000), Dessy and Pallage (2001), Jafarey and Lahiri (2002), Dessy and Vencatachellum (2003), Doepke and Zilibotti (2005). The empirical literature on child labor is very rich, with contributions by Grootaert and Kanbur (1995), Canagarajah and Coulombe (1997), Ravallion and Wodon (2000), Edmonds (2005), Edmonds and Pavcnik (2005).

3.3 The model

The structure of this Section is as follows. We start by setting up the model environment. We then derive a series of lemmas all of which culminate in the characterization of a general equilibrium for this economy. The final proposition establishes the limits of supply-side policy intervention at the local level.

We consider an economy populated by ex ante identical households, in total size normalized to unity. Following Swinnerton and Rogers (2005), we assume that there are also $\bar{k}$ entrepreneurs living in the economy, each endowed with one unit of capital. Therefore $\bar{k}$ is both the total number of entrepreneurs and the quantity of capital existing in this economy. Entrepreneurs have two options for earning a return on their endowment of capital. One is to combine capital and hired labor to produce the unique consumption good; the other is to engage in child trafficking, by illegally transporting abducted children and selling them abroad for profit. We denote by k_L the population of legitimate entrepreneurs, and by k_T that of child traffickers, with $k_L + k_T = \bar{k}$. Both k_L and k_T are determined endogenously.

All households are initially composed of an adult-child pair. Parents are altruistic in the sense that they love their children and would suffer from their disappearance. Children do nothing in this environment, apart from enjoying parental care and supervision, when offered. As long as there are entrepreneurs who find it beneficial to become child traffickers, all parents will be exposed to the risk of losing their offspring. Child trafficking is a criminal activity, which is fought in part through public enforcement of laws that guarantee child safety and protection, and in part through parental investment in child protection. We denote as g the level of public expenditures in anti-child-trafficking

law-enforcement, and by x_i, the level of private investment in child protection by parent $i \in [0,1]$. The total barrier available for the protection of the child of parent i is given by:

$$b_i = B(x_i, g), \tag{3.1}$$

We impose the following restriction on the behavior of the function B:

Assumption 3.1: $B(x_i, g) = x_i + g \ \ \forall i$.

Assumption 3.1 states that private and public investments are additively separable contributions to a child's protective environment.

Given the level of protective barrier surrounding children in this environment, an entrepreneur j who decides to engage in the child trafficking business must choose the level of effort, e_j, necessary to break down barriers set up by both parents and the government. The aggregate child trafficking effort, e, in this environment is measured by:

$$e = \int_0^{k_T} e_j dj, \tag{3.2}$$

Each parent i knows the conditional probability, ρ_i, that his child will be trafficked away if he is protected by a barrier of level b_i, when the aggregate intensity of trafficking within the community is e. This conditional probability is described by the following function P, whose behavior is made precise in Assumption 3.2:

$$\rho_i = P(b_i, e). \tag{3.3}$$

Assumption 3.2: *Function P satisfies the following properties: (1) $P_b < 0$; (2) $P_e > 0$; (3) $P_{bb} \geq 0$; (4) $P_{be} < 0$; (5) $P(b_i, 0) = 0$.*

Part (1) of Assumption 3.2 states that increasing the level of child protection reduces a child's vulnerability to traffickers. Part (2) reflects the fact that an increase in the intensity of trafficking raises the risk that a child will fall victim to traffickers. Part (3) implies that *ceteris paribus*, the incremental reduction in the probability of victimization

decreases as barriers are raised. It also implies that P is bounded below. Part (4) states that the incremental gain from raising the level of protective barriers is decreasing in the level of aggregate trafficking effort. Part (5) implies that there is no risk of child out-trafficking when no trafficking activity takes place.

Each parent is endowed with one unit of labor, which is inelastically supplied to legitimate entrepreneurs, in exchange for a wage, ω. After earning his labor income, each parent then bears a child, invests x_i for his child safety and protection, and allocates the remainder, $\omega - x_i$, to household consumption, c_i, of the unique consumption good. Trafficking activity then possibly begins. A parent whose child is safe and protected enjoys a utility $u(c_i)+\delta$, where δ denotes the utility derived from raising a well-protected child. In contrast, a parent whose child is trafficked away misses out on the utility the child once provided and his utility reduces to $u(c_i)$, where $c_i \leq \omega - x_i$. The function u satisfies $u' > 0$, $u'' < 0$.[4]

3.3.1 Production of the consumption good

We take the consumption good as the economy's numeraire. In the production process of this good, entrepreneurs are residual claimants, and exhibit a price-taking behavior in both the labor and the output markets, respectively. An entrepreneur who combines his unit endowment of capital with l units of labor achieves a level of output given by $\theta f(l)$, where $\theta > 0$ denotes a productivity parameter, which we take as a proxy for the economy's level of development. The function f satisfies $f' > 0$, $f'' < 0$, $f(0) = 0$, as well as Inada conditions. Capital totally depreciates after its use in the production process. Given our normalization of the parent-worker population size, total labor supply is equal to 1. Since all legitimate entrepreneurs operate an identical technology, in equilibrium, perfect competition implies that they all hire the same amount of labor,

[4]It can be argued that the disutility of losing a child is potentially much larger than δ and possibly infinite. Since we do observe children sent to the labor market in spite of the risk of trafficking, it must be, however, that this cost is bounded above. In absence of better information, we assume without loss of generality that losing one's child implies the loss of the utility the presence of the child provided the parents.

$l = 1/k_L$, and pay a competitive wage given by:

$$\omega = \theta f'(1/k_L). \tag{3.4}$$

Let r_L denote the residual claimed by a legitimate entrepreneur. Price-taking behavior implies that this residual is given by:

$$r_L = \theta \left[f(1/k_L) - f'(1/k_L)(1/k_L) \right]. \tag{3.5}$$

It is immediate to establish that $\partial r_L / \partial k_L = 1/k_L^3 f'' < 0$. The return to legitimate entrepreneurship thus decreases with the number of entrepreneurs, k_L, pursuing a legitimate productive activity. This result has important implications for the supply of trafficked children.

3.3.2 Child trafficking technology

Child traffickers are self-employed agents who abduct children from their home and ship them abroad in exchange for profit. They combine their unit endowment of capital and their own effort, e_j, to break down barriers to child trafficking set up by the government and by the parents, where $j \in [0, k_T]$. Given the level of private and public barriers against child trafficking, it is clear that the number, n_T, of children trafficked out of the community will be proportional to the total number of children living in the economy: $n_T = \alpha$, where $\alpha \in [0, 1]$. The share α is endogenously determined.

Child traffickers compete for a share of the victims. The number, n_{Tj}, of children successfully trafficked away by trafficker j is thus given by:

$$n_{Tj} = \alpha \beta_j, \quad j \in [0, k_T], \tag{3.6}$$

where

$$\beta_j = \frac{(e_j)^\lambda}{\int_0^{k_T} (e_\iota)^\lambda \, d\iota}, \qquad j \in [0, k_T], \tag{3.7}$$

and λ denotes the degree of competition between child traffickers. The shares $\beta_j \in [0, k_T]$

are then determined endogenously by individual traffickers' efforts. With respect to the value taken by λ, we make the following assumption:

Assumption 3.3: *We assume that there is a certain level of tacit collusion among traffickers, so that λ is relatively close to 0.*

This assumption reflects the fact that traffickers operate in extremely well organized rings, which could hardly be obtained in an environment of fierce competition.

We also assume for simplicity that the total cost of exerting a child trafficking effort is linear in this effort and equal to γe_j, with $\gamma > 0$.[5] Denoting by q the exogenously given world price of each child victim sold abroad, we can write agent j's return to child trafficking as:

$$r_{Tj} = \alpha q \beta_j - \gamma e_j. \tag{3.8}$$

3.3.3 The problem of a typical household

Parents maximize expected utility. A typical parent i solves:

$$\max_{x_i} \{u(\omega - x_i) + (1 - \rho_i)\delta\}$$
$$\text{s.t. (3.1) and (3.3)}$$

After substituting in the constraints, the objective function can be rewritten as:

$$V(x_i, e, g, \omega) \equiv u(\omega - x_i) + (1 - P[B(x_i, g); e])\delta. \tag{3.9}$$

The following lemma characterizes the optimal level of parent i's investment in child protection:

Lemma 3.1: *Let Assumptions 3.1 and 3.2 hold. Then the optimal parental investment in child protection is a function X defined by*

$$X(e, g, \omega) = \arg\max_{x_i} V(x_i, e, g, \omega)$$

[5]This cost may include, for example, transportation costs, and/or other costs necessary to break down protective barriers set up by both the parent and the government.

such that (i) $X_e > 0$; (ii) $X_g < 0$; and (iii) $X_\omega > 0$.

Proof: The first order condition for a maximum of (3.9) is:

$$-u' - P_b\delta = 0$$

Given the properties of the functions u and P, this first order condition is also sufficient for a maximum. The proof then simply follows from taking the total derivative of this first order condition and applying the Implicit Function Theorem. ■

Part (i) of Lemma 3.1 states that parental investment in child protection rises with the intensity of child trafficking in the economy. Part (ii) states that an exogenous increase in the level of public expenditures financing law-enforcement against child trafficking tends to cause parents to decrease their own investment in child protection. This result is a direct implication of the substitutability between private and public investment. Part (iii) implies that richer parents invest more in child protection than poorer ones.

As an implication of Lemma 1, the conditional probability that a child will be trafficked out of the community can be rewritten as follows using (3.3):

$$\hat{P}(e, g, \omega) \equiv P[X(e, g, \omega) + g, e] \tag{3.10}$$

Hence the following lemma:

Lemma 3.2: *Under Assumptions 3.1 and 3.2, and as long as the cost of losing a child is not prohibitive, the function $\hat{P}$ exhibits the following properties: (i) $\hat{P}_e > 0$; (ii) $\hat{P}_g < 0$; (iii) $\hat{P}_\omega < 0$.*

Proof: To prove part (i), take the partial derivative of $\hat{P}$ with respect to e:

$$\hat{P}_e = P_b X_e + P_e \tag{3.11}$$

with $X_e = \frac{\delta P_{be}}{u'' - \delta P_{bb}}$. Substituting this expression back into (3.11) yields $\hat{P}_e > 0$, for δ small enough.

To prove part (ii), take the partial derivative $\hat{P}$ with respect g:

$$\hat{P}_g = \frac{u'' P_b}{u'' - \delta P_{bb}} < 0$$

since $P_b < 0$. The proof of claim (iii) follows in the same manner. ■

Part (i) of Lemma 3.2 states that the conditional probability that a child will be trafficked in this environment rises with an increase in the aggregate intensity of trafficking. The direct effect on $\hat{P}$ of an increase in e outweighs the subsequent decrease in that probability caused by the response of parents in terms of improved child protection. Part (ii) states that an increase in the level of public investment in child protection reduces this probability. Finally part (iii) states that this probability is lower the wealthier the household in which the child lives.

It is important to note that by the law of large numbers, the conditional probability, $\hat{P}(e, g, \omega)$, can be interpreted as the proportion α of children actually victims of child traffickers, when the intensity of the child trafficking activity is e, and the state of nature is given by (g, ω):

$$\alpha = \hat{P}(e, g, \omega). \tag{3.12}$$

3.3.4 Inter-sectoral allocation of entrepreneurs

A typical trafficker j's problem is to choose the level of individual effort, e_j, that solves the following program:

$$\max_{e_j} r_{Tj} \tag{3.13}$$
$$\text{s.t.(3.7) and (3.8)}$$

Assuming that each trafficker does not internalize the impact of his action on the others, the first order condition for problem (3.13) is:

$$e_j = \alpha q \bar{\lambda} \beta_j, \qquad j \in [0, k_T] \tag{3.14}$$

where β_j is defined in (3.7) and $\bar{\lambda} = \lambda \gamma^{-1}$. Since traffickers are homogeneous and non-strategic, they all choose to exert exactly the same level of effort so that $e_j = e^*$, for all j. Consequently, each trafficker's market share is $\beta_j = \beta^* = 1/k_T$.

Therefore, using (3.12) and (3.14), the equilibrium effort e^* is characterized by the following equation:

$$\Upsilon\left(e^*, g, q, \theta, k_T\right) = 0, \tag{3.15}$$

where k_T denotes the total population of child traffickers, and

$$\Upsilon\left(e^*, g, q, \theta, k_T\right) \equiv k_T e^* - \hat{P}\left(e^* k_T, g, \theta f'\left[\left(\bar{k} - k_T\right)^{-1}\right]\right) q\bar{\lambda}. \tag{3.16}$$

Lemma 3.3: *Under Assumptions 1, 2 and 3, the trafficking effort e^* chosen by each child trafficker exists and is a function E defined by:*

$$\Upsilon\left[E\left(g, q, \theta, k_T\right), g, q, \theta, k_T\right] \equiv 0,$$

such that: (i) $E_g < 0$; (ii) $E_q > 0$; (iii) $E_\theta < 0$; (iv) $E_k < 0$.

Proof: Using (3.16), we take in turn the derivatives of Υ with respect to each argument:

$$\begin{aligned}
\Upsilon_e &= \left[1 - q\bar{\lambda}\hat{P}_e\right] k_T \\
\Upsilon_g &= -q\bar{\lambda}\hat{P}_g \\
\Upsilon_q &= -\bar{\lambda}\hat{P}\left(e^* k_T, g, \theta f'\left[\left(\bar{k} - k_T\right)^{-1}\right]\right) \\
\Upsilon_\theta &= -q\bar{\lambda} f'\left[\left(\bar{k} - k_T\right)^{-1}\right] \hat{P}_\omega \\
\Upsilon_k &= \left[1 - q\bar{\lambda}\hat{P}_e\right] e^* - q\bar{\lambda}\left(\bar{k} - k_T\right)^{-2} \theta f'' \hat{P}_\omega.
\end{aligned}$$

Using Assumption 3.3, as $\lambda \to 0$, so does $\bar{\lambda} \to 0$, and we have $\Upsilon_e > 0$ and $\Upsilon_k > 0$, since $\hat{P}_e > 0$ and $\hat{P}_\omega < 0$. Furthermore, $\Upsilon_g > 0$, since $\hat{P}_g < 0$. Finally, $\Upsilon_q < 0$ and $\Upsilon_\theta > 0$ by inspection. The results then follow from the application of the Implicit function's theorem. ■

Lemma 3.3 characterizes the response of local traffickers to changes in their environment. It shows that an exogenous increase in the level of public expenditures allocated to anti-child-trafficking law-enforcement tends to induce traffickers to reduce their trafficking effort [Part (i)]. So does economic development [Part (iii)]. Exogenous increases in the international price for trafficked children tend to stimulate traffickers' effort [Part (ii)]. An increase in the number of traffickers has a negative effect on the effort level chosen by each trafficker [Part (iv)]. All these effects are quite intuitive. However, these are only partial equilibrium effects, as the number of child traffickers will adjust in equilibrium. We next characterize the equilibrium inter-sectoral allocation of entrepreneurs.

A general equilibrium for this economy exists if and only if there exists, k_T^*, such that $r_L = r_T$, and $k_L^* = \bar{k} - k_T^*$. In other words, entrepreneurs in equilibrium must be indifferent between either market. If this were not the case, there would be movements of entrepreneurs across markets until returns are equalized. We now proceed to show that such an equilibrium exists and is unique.

First, note that after substituting $e^* = E(g, q, \theta, k_T)$ in (3.10), the incidence of child trafficking is:

$$\alpha = \widetilde{P}(k_T, g, q, \theta) \tag{3.17}$$

where

$$\widetilde{P}(k_T, g, q, \theta) \equiv \hat{P}\left(k_T E(g, q, \theta, k_T), g, \theta f'\left[\left(\bar{k} - k_T\right)^{-1}\right]\right). \tag{3.18}$$

Lemma 3.4: *Under Assumptions 3.1, 3.2 and 3.3, the function $\widetilde{P}$ has the following properties: (i) $\widetilde{P}_k > 0$; (ii) $\widetilde{P}_g < 0$; (iii) $\widetilde{P}_q > 0$; (iv) $\widetilde{P}_\theta < 0$.*

Proof: Using (3.18) we can derive the above partial equilibrium effects as follows:

$$\begin{aligned}
\widetilde{P}_k &= [e^* + k_T E_k]\,\hat{P}_e + \theta\left(\bar{k} - k_T\right)^{-2} f''\hat{P}_\omega \\
\widetilde{P}_g &= k_T \hat{P}_e E_g + \hat{P}_g < 0 \\
\widetilde{P}_q &= k_T \hat{P}_e E_q > 0 \\
\widetilde{P}_\theta &= f'\hat{P}_\omega < 0.
\end{aligned}$$

First, observe from the proof of Lemma 3.3 that as $\bar{\lambda} \to 0$, $k_T E_k \to -e^*$, so that $\widetilde{P}_k \to \theta\left(\bar{k} - k_T\right)^{-2} f''\hat{P}_\omega$, which is positive, since $\hat{P}_\omega < 0$ and $f'' < 0$. Hence $\widetilde{P}_k > 0$. The sign of the other partial effects all follow from Lemma 3.3. Hence the results. ■

Next, we characterize the optimal return to capital in the child trafficking activity, $r_T = R^T(k_T, g, q, \theta)$, as follows:

$$R^T(k_T, g, q, \theta) = \frac{q}{k_T}\widetilde{P}(k_T, g, q, \theta) - \gamma E(g, q, \theta, k_T). \tag{3.19}$$

The partial equilibrium effects on the return to capital in the child-trafficking sector are summarized in the following Lemma:

Lemma 3.5: *Under Assumptions 3.1, 3.2 and 3.3, the function R^T has the following properties: (i) $R^T_k < 0$; (ii) $R^T_g < 0$; (iii) $R^T_q > 0$; (iv) $R^T_\theta < 0$.*

Proof: The partial derivatives of R^T with respect to each of its arguments are given by:

$$R^T_k = -\frac{q\widetilde{P}(k_T, g, q, \theta)}{(k_T)^2} + \frac{1}{k_T}\left[q\widetilde{P}_k - \gamma k_T E_k\right] \tag{3.20}$$

$$R^T_g = \frac{1}{k_T}\left[q\widetilde{P}_g - \gamma E_g k_T\right] \tag{3.21}$$

$$R^T_q = \frac{1}{k_T}\left[\widetilde{P}(k_T, g, q, \theta) + q\widetilde{P}_q - \gamma E_q k_T\right] \tag{3.22}$$

$$R^T_\theta = \frac{1}{k_T}\left[q\widetilde{P}_\theta - \gamma E_\theta k_T\right] \tag{3.23}$$

Claim 1: $R^T_k < 0$. Again, from the proof of Lemma 3.3 as $\bar{\lambda} \to 0$, $k_T E_k \to -e^*$, which,

when substituted back into (3.20), implies:

$$R_k^T = -\frac{1}{k_T}\left[R^T\left(k_T, g, q, \theta\right) - q\widetilde{P}_k\right].$$

We know from the proof of Lemma 4 that for $\bar{\lambda} \to 0$, $\widetilde{P}_k \to \theta\left(\bar{k} - k_T\right)^{-2} f'' \hat{P}_\omega$. Finally, using Lemma 3.2, we end up with:

$$\widetilde{P}_k \approx -\frac{\theta\left(\bar{k} - k_T\right)^{-2}}{-u'' + \delta P_{bb}} P_b u'' f''.$$

Now observe that we can always choose the functions P, u and f such that $-P_b u'' f'' \to 0$. Hence the result. ■

Claim 2: $R_g^T < 0$. From (3.21), consider the difference $\triangle_g = q\widetilde{P}_g - \gamma E_g k_T$. We need to show that this difference is negative. From Lemma 3.4, it can be shown by way of substitution that:

$$\triangle_g = q k_T \hat{P}_e E_g + q\hat{P}_g - \gamma E_g k_T.$$

Lemma 3.3 implies:

$$\gamma E_g k_T = \frac{\lambda q \hat{P}_g}{\left[1 - q\bar{\lambda}\hat{P}_e\right]}$$

since $\bar{\lambda} = \lambda/\gamma$. Substituting back into $\triangle_g$ and re-arranging terms yields:

$$\triangle_g = q k_T \hat{P}_e E_g + q\hat{P}_g\left[1 - \frac{\lambda}{1 - q\bar{\lambda}\hat{P}_e}\right] < 0$$

for $\lambda \to 0$. Hence the result.

Claim 3: $R_q^T > 0$. From (3.22), consider the difference $\triangle_q = q\widetilde{P}_q - \gamma E_q k_T$. It suffices to show that this difference is non-negative. From Lemma 3.3 and Lemma 3.4, we have:

$$\triangle_q = \left[q\hat{P}_e - \gamma\right] k_T E_q.$$

We can always choose γ and the function P such that $q\hat{P}_e - \gamma \geq 0$.

Claim 4: $R_\theta^T < 0$. Again, from (3.23), consider the difference $\triangle_\theta = q\widetilde{P}_\theta - \gamma E_\theta k_T$.

From Lemma 3 and Lemma 3.4, we have:

$$\triangle_\theta = f'\hat{P}_\omega \left[1 - \frac{\lambda q}{1 - q\bar{\lambda}\hat{P}_e}\right] < 0$$

for $\lambda \to 0$. Hence the result. ■

Property (i) of Lemma 3.5 states that the return to capital in the child trafficking activity is decreasing in the number of entrepreneurs who choose to invest in child trafficking. Property (ii) states that this return also decreases with an increase in the level of public expenditures allocated to better enforcement of anti-child trafficking laws. Property (iii) states that an exogenous increase in the worldwide price for trafficked children from the rest of the world causes this return to rise. Property (iv) implies that this return is higher, the poorer the economy.

Next, let us re-write the return to capital in the legitimate sector, using (3.5):

$$R^L(k_T, \theta) = \theta\left(f\left[L(k_T)\right] - f'\left[L(k_T)\right]\left(L(k_T)\right)\right), \tag{3.24}$$

where

$$L(k_T) = \frac{1}{\bar{k} - k_T} \tag{3.25}$$

Clearly, the richer the economy, the higher the return to legitimate entrepreneurship: $R^L_\theta > 0$.

Furthermore, since $L' > 0$, the smaller the number of legitimate entrepreneurs (i.e., the higher k_T), the higher the return to legitimate entrepreneurship:

$$R^L_k = -\frac{1}{\left(\bar{k} - k_T\right)^3} f'' > 0.$$

Finally, we define

$$\sigma(k_T, g, q, \theta) \equiv R^T(k_T, g, q, \theta) - R^L(k_T, \theta) \tag{3.26}$$

to be the net gain from choosing illegitimate entrepreneurship (i.e., child trafficking).

The following Lemma obtains as an implication of Lemma 3.5:

Lemma 3.6: *Under Assumptions 3.1, 3.2 and 3.3, the function σ has the following properties: (i) $\sigma_k < 0$; (ii) $\sigma_g < 0$; (iii) $\sigma_q > 0$; (iv) $\sigma_\theta < 0$.*

Property (i) of Lemma 3.6 states that the net gain from engaging in child out-trafficking decreases with the number of agents who opt for this strategy as a means to earn a return on their capital. Property (ii) states that this net gain decreases the more active the government is in enforcing the law against child out-trafficking. Property (iii), in contrast states that an exogenous increase in the international price for trafficked children causes this net gain to rise. Property (iv) states that this net gain is higher in poorer countries than in their richer counterparts.

We define a general equilibrium for this economy as a situation where entrepreneurs are indifferent as to the sector in which they invest their capital. In other words, in equilibrium, returns to capital are equalized across both sectors:

$$\sigma\left(k_T, g, q, \theta\right) = 0. \tag{3.27}$$

A *general equilibrium* is therefore an inter-sectoral allocation of capital (k_L^*, k_T^*), and an incidence of child out-trafficking α^*, such that (i) k_T^* solves (3.27), (ii) $k_L^* = \bar{k} - k_T^*$, and (iii)

$$\alpha^* = \widetilde{P}\left(k_T^*, g, q, \theta\right). \tag{3.28}$$

The following Lemma obtains as an implication of Lemma 3.6 and the Implicit Function Theorem:

Lemma 3.7: *Under Assumptions 3.1, 3.2 and 3.3, there exists a function κ defined by $\sigma\left[\kappa\left(g, q, \theta\right), g, q, \theta\right] \equiv 0$ such that: (i) $\kappa_g < 0$; (ii) $\kappa_q > 0$; (iii) $\kappa_\theta < 0$, where $k_T^* = \kappa\left(g, q, \theta\right)$, denotes the value of k_T that solves (3.27).*

Lemma 3.7 shows that, *ceteris paribus* the number of child traffickers within a given source country decreases with better law-enforcement. Traffickers react to the international price for children: a higher price, *ceteris paribus* attracts more traffickers in the business. This can happen either if the world supply is curbed or if the world demand expands. Moreover, Lemma 7 states that the proportion of child traffickers is higher in

poorer than in richer countries. There are two underlying causes for this result. On one hand, where poverty is pervasive, parents do not invest adequately in child protection; this weakens the household as an effective protective unit against child trafficking. On the other, poverty may push entrepreneurs to seek the higher returns to capital provided in the illegitimate trafficking business.

By characterizing the solution to equation (3.27), Lemma 3.7 also implicitly establishes the following proposition:

Proposition 3.1: *Under Assumptions 1, 2 and 3, an equilibrium exists and is unique.*

We now turn to the discussion of policy action.

3.3.5 Policy responses to child trafficking in a source-country

Using (3.28) and substituting in the equilibrium k_T^*, the equilibrium incidence of child trafficking boils down to the following function:

$$\alpha^* = P^*(g, q, \theta),$$

where $P^*(g, q, \theta) \equiv \widetilde{P}[\kappa(g, q, \theta), g, q, \theta]$.

The following Lemma obtains as an implication of Lemma 7.

Lemma 3.8: *Under Assumptions 1, 2 and 3, the function P^* has the following properties: (i) $P_g^* < 0$; (ii) $P_q^* > 0$; (iii) $P_\theta^* < 0$.*

Proof: Taking the partial derivatives of P^* with respect to its arguments and using the previous Lemmas, we find:

$$\begin{aligned} P_g^* &= \widetilde{P}_k \kappa_g + \widetilde{P}_g < 0 \\ P_q^* &= \widetilde{P}_k \kappa_q + \widetilde{P}_q > 0 \\ P_\theta^* &= \widetilde{P}_k \kappa_\theta + \widetilde{P}_\theta < 0. \end{aligned}$$

■

Property (i) of Lemma 3.8 states that *ceteris paribus* better law-enforcement financed by an increase in public investment reduces the incidence of child trafficking. However, this effect can be undermined by any mechanism that puts an upward pressure on the international price for children [property (ii)]. Similar supply-side policies abroad typically have this effect. Property (iii) states that economic development causes the incidence of child out-trafficking to decline. As the wealth of households increases, with economic development, these households become more effective protective units for their children. Property (iii) therefore explains why poorer countries are more likely to be source countries for child trafficking, while richer countries are more likely to be destination countries.

However, since the source country acting in autarky cannot influence the international demand for trafficked children, policy discussions of the eradication of child trafficking that emphasize supply-side interventions in source countries are likely to fail if they ignore the negative spillover caused by similar policies elsewhere. Increased police inspections, border patrols, and raising public awareness, while necessary, are not by themselves sufficient for the complete elimination of child trafficking in source countries. In our model, complete elimination of child out-trafficking by government officials acting in autarky would imply that the level of public expenditures on law-enforcement, g, be chosen such that $P^*(g, q, \theta) = 0$. The following proposition characterizes the determinants of that level. It is a straightforward application of Lemma 8.

Proposition 3.2: *There exists a function G defined by $P^*[G(q,\theta), q, \theta] \equiv 0$, such that (i) $G_q > 0$, and (ii) $G_\theta < 0$, where $G_j = \partial G/\partial j$, $j = q, \theta$.*

Proposition 3.2 implies that any action that causes the international price for trafficked children to rise generates a negative externality on the fight against child trafficking in a source country: it causes the level of public expenditures necessary for a complete elimination of child trafficking to increase (i.e., $G_q > 0$). Proposition 3.2 also

suggests that, in poorer countries, the burden of fighting child trafficking almost lies entirely with the government. The poorer the country, the higher the level of public expenditures necessary to completely eliminate child trafficking (i.e., $G_\theta < 0$). In poorer countries, parents are less capable of providing adequate protection for their children. Hence governments may need to make a disproportionate contribution to child protection as compared to richer countries.

There is an element of tragedy in Proposition 3.2. On the one hand, it implies that only international coordination can fight child trafficking. On the other hand, it suggests that policies aimed at fighting the supply alone are misguided. The problem with Proposition 3.2 is that it mimicks the myopic reasoning of an individual country assuming that its actions do not affect the world price for trafficked children. Clearly, this is a mistake. As all countries can apply the same reasoning, policies to combat traffickers will curb the supply, make the price skyrocket and attract more traffickers into the business. The fight of child trafficking from the supply side only is therefore utterly vain. The prerequisited policies are those that put a negative pressure on the world price of children. Such policies invariably lead us to a fight on the demand. Indeed, if destination countries first target the demand, they make it easier for source countries to fight the supply, as Proposition 3.2 suggests.

This chapter argues that simply sending traffickers to jail, while this may serve justice well, will hardly reduce the trafficking of children. Removing a trafficker from the field makes the business more profitable to other traffickers and attracts more entrepreneurs into the trade, unless action is also taken to make the price drop. Making it too costly for pedophiles to risk having sexual relations with children at home or in other destination countries is an important element of such policy.[6] Prosecuting those who use child soldiers is another. Deterring penalties should be designed for each pilar of the demand. For this attack on the demand side, coordinated action at the global level is important. Adopting a strong and unified penal code on the use of trafficked children is a first step. Enforcing such code is the second. As rich countries tend to suggest that poor countries, by being too lenient on traffickers, are responsible for the

[6] Adopting and enforcing child sex tourism legislation is an important step.

trafficking business, it may come as a cold shower to realize that a successful policy intervention first implies a fight in their own backyard.

3.4 Concluding remarks

This chapter develops a model to advocate the need for an internationally coordinated action against child trafficking between source and destination countries. The model emphasizes the microeconomics of both children's vulnerability to trans-boundary trafficking and individual entrepreneurs' decision to engage in the business of child trafficking.

Our results shed light on the externality the actions of richer countries may exert on poorer countries in the fight against child trafficking. In particular, it does not seem appropriate for rich countries to pressurize poor countries to immediately adopt similar protection mechanisms as the ones they have already put in place. On the one hand, putting such pressure on poor countries would imply disregarding the fact that it is more costly for poor countries to achieve the same protection of their children. Well intended actions of rich countries have indeed pushed up the price for children. Second, the fight against child trafficking cannot neglect the demand side. As long as the price is high enough, there will be traffickers. Prior to further supply-side policies, governments need to find a way to make the price of trafficked children drop. Coordinated action on the demand side by destination countries is thus a prerequisite to supply-side policies in source countries. Clearly international cooperation is at the core of any successful intervention.

Table 3.1 : An Overview of Intenational Child Trafficking Flows

Regions	Source Countries (GDP per capita)		Receiving Countries (GDP per capita)	
Africa	Benin	(1,070)	Nigeria	(875)
			Cote d'Ivoire	(1,500)
			Cameroon	(1,700)
			Gabon	(5,700)
	Mali	(860)	Cote d'Ivoire	(1,500)
	Togo	(1,500)	Cameroon	(1,700)
			Gabon	(5,700)
			Nigeria	(875)
South and South-East Asia	Malaysia	(9,300)	Taiwan	(18,000)
			Australia	(27,000)
			Japan	(28,000)
			Hong Kong	(26,000)
	Nepal	(1400)	Pakistan	(2,100)
	Bangladesh	(1,700)	India	(2,540)
Latin and Central America	Honduras	(2,600)	Canada	(29,400)
	Costa Rica	(8,500)	United States	(37,000)
			Canada	(29,400)
Eastern Europe	Albania	(4,500)	Italy	(25,000)
			Greece	(19,000)
	Lithuania	(8,400)	Germany	(26,600)
			Denmark	(29,000)
			Netherlands	(26,900)
			Israel	(19,000)

(Sources : Unicef and World Bank. GDP per capita in PPP from *The World factbook 2003*)

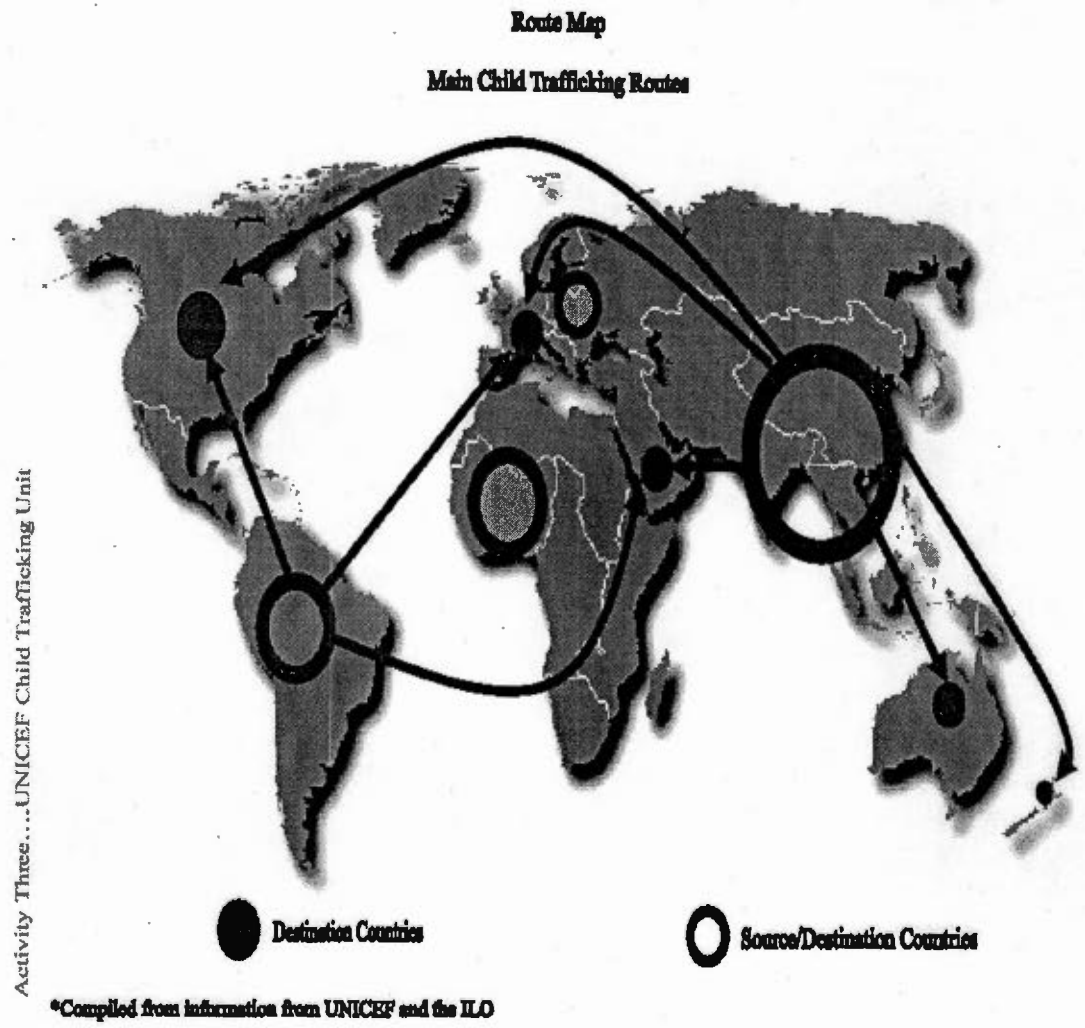
Route Map
Main Child Trafficking Routes
Destination Countries
Source/Destination Countries
*Compiled from information from UNICEF and the ILO
Activity Three....UNICEF Child Trafficking Unit

Figure 3.a

General Conclusion

Over the recent years there has been a growing interest for individual behaviors in order to gain better insights into the development process. The breakthroughs in both micro and macro economics hugely contributed in placing micro foundations at the heart of the development analysis. The research undertaken in the frame of my thesis is in line with this practice. My goal when building from the micro level has been to rely upon individual decisions by some optimizing agents to understand the dynamics of economic development. This explains why echoing to the idea that '*human capital is the engine of economic development*,' the first essay develops a model where trade liberalization changes factors' relative demands and gives rise to a skill premium in wage which provides individuals with the requisite incentive for human capital accumulation.

Assuming that the economy under consideration has a comparative advantage in crop production, trade liberalization causes the relative prize of the import competing good to fall. The import competing sector then shrinks under foreign competition, and releases productive resources that can be used in the other sectors of the economy. In the first essay my theory lies on the idea that skilled labor flows into the agricultural research and extension services sector, whereas physical capital is relocated in agriculture. Combining physical capital with inputs from the intermediate sector ultimately triggers a process of capital augmenting technical progress, whereby physical capital substitutes for unskilled labor in agriculture. As agricultural output expands using more and more inputs from the research and extension services sector, the demand for skilled labor rises and pushes the expected return to education up. Considering that physical capital is also substituting for unskilled labor in agriculture,

the skill premium in wage rises and acts as a catalyst for human capital accumulation. Structural transformation of the economy then follows from this process.

The process of trade-induced structural transformation as described above, not only has the appealing feature to be based on individual optimizing decisions, but also seems to match some recent development experiences such as India or Brazil, both which experts now consider as emerging economies. According to my analysis, trade barriers set or faced by developing countries are accountable for underdevelopment.

The development mechanics hence highlighted clearly points to a major role of education in fostering the process. The provision of educational resources therefore, appears to be of prime importance. However, in many developing countries, access to quality education is a privilege afforded only to an elite group, hence the relevance of my second essay, which investigates the conflicts surrounding the allocation of public educational resources.

In chapter 2, I consider a setting where investment in a child's education can either have a private or a public source in a multi-group society. Since public educational resources are limited, individuals belonging to the same social group (defined on the basis of race, religion, or ethnicity), may have a vested interest in excluding members of other social groups from sharing in. This explains the competition over publicly-funded educational resources, which may give rise to social exclusion in the sense that some groups are left out. Under these considerations and assuming that everyone in the society has the opportunity to vote over the degree of exclusion to be tolerated in the society, I show that social exclusion cannot emerge within a society with no or low asymmetry in population size. However, to the extent that there is a significant asymmetry in population size, the majority group may have an interest in supporting a high degree of exclusion. this is because each member of the majority only contribute a small amount in the contest effort of its group relative to other groups members, which implies that they can privately invest more resources in their offspring's education.

My results therefore points to the immigration policy as a device to reduce population size asymmetry, allowing a democratic voting system to impede the emergence of social exclusion.

My analysis of social exclusion also illustrates the fact that it not always the case that households as a whole will all be able to afford the same level of expenditure to the benefit of their offspring. The USDA's annual reports clearly show that households' investment in teens' education increases with parental income. Moreover, in poor countries, parents may not be able to adequately invest in they child's wellbeing. Poverty and low public resources sometimes combine to give rise to a situation where children do not enjoy a safe environment out of the familial frame. This makes them as much potential victims for well organized networks of criminals lying in wait.

In my final essay I show that as some countries' effectiveness in fighting child traffickers increases, criminals switch their activities towards countries with less effective protection, whether because poverty makes households too dependant upon public resources in child protection, or because of governmental failures in enforcing the law. This arises from the fact that for a given demand for child victims, curbing the supply in some countries pushes the international price of a victim up, providing criminals with the incentive to increase their efforts to lure and corrupt children elsewhere. Coping with trafficking activities in other countries hence becomes harder, and this explains why in relative terms, trafficking flows are from poor to rich countries.

My analysis therefore illustrates the limits of existing international conventions which only call for more laws to punish traffick in human beings. Beyond the adoption of more laws or conventions, I question the capacity of some countries to implement such measures absence of more cooperation at the international level. Such cooperation may take the form of information sharing, technical and logistic assistance, or even multilateral agreements to sue traffickers no matter states' boundaries.

Overall my thesis tackles very different issues facing today's developing countries and provides some policy recommendations as to how to cope with the respective stakes. Building from micro foundations allows me to clearly illustrate the forces coming into play, which also implies a better understanding of the channels through which such policies may affect people's behavior.

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