Trade, Foreign Investment, and Industrial Policy

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Trade, Foreign Investment, and Industrial Policy for Developing Countries*

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1 Introduction

> "...growth was not a passive, trickle-down strategy for helping the poor. It was an active, pull-up strategy instead. It required a government that would energetically take steps to accelerate growth, through a variety of policies including building infrastructure such as roads and ports and attracting foreign funds."
>
> Jagdish Bhagwati, *In Defense of Globalization* (2004)

During the last three decades, developing countries have made enormous strides in opening up their protected domestic markets to international trade and foreign investment. Yet most countries have not simply opened up their markets. They have also instituted a range of policies to encourage exports, attract foreign direct investment (FDI), promote innovation, and favor some industries over others. This leads to the following question: is openness to trade and FDI alone sufficient to achieve high growth rates in developing countries? If harnessing the gains from globalization requires additional policies, can we identify them? While some types of complementary policies, such as building roads and ports, are not controversial, others are. Bhagwati's suggestion to "attract foreign funds" implies tilting incentives in favor of foreign investors, which means abandoning policy neutrality. Our goal in this chapter is to explore the popular but controversial idea that developing countries benefit from abandoning policy neutrality vis-a-vis trade, FDI and resource allocation across industries.

Policy neutrality does not necessarily mean free trade, or a neutral stance regarding taxation of multinational corporations, or even a common tax structure for all industries. Both optimal tax theory and practical fiscal considerations imply that countries (especially poor ones) will often want to rely on tariffs as a source of revenue or set different tax rates across industries. Are developing countries justified in imposing tariffs, subsidies, and tax breaks that imply distortions beyond the ones associated with optimal taxes or revenue constraints? We refer to this set of government interventions as "industrial policy".

The presence of externalities is the main theoretical justification for deviating from policy neutrality. Learning externalities from exports could justify export subsidies; knowledge spillovers from foreign companies could justify tax breaks for FDI; production externalities in "advanced" sectors

could justify infant-industry protection or other measures to expand those industries. We begin this review with a series of simple models to highlight the role of Marshallian and inter-industry externalities, industry-level rents, sector-specific coordination failures and information spillovers as a rationale for industrial policy ("IP").

The main message that emerges from this review is that the theoretical justification for infant-industry protection requires at a minimum either that the country have a latent comparative advantage in the protected industry or that the international price for this industry is higher than warranted by the true opportunity cost of this good in the rest of the world. Moreover, for protection to deliver large gains, the protected industry must exhibit large Marshallian externalities. In contrast to the temporary trade barriers associated with infant-industry protection, permanent protection of a sector may be warranted if it generates positive externalities to other sectors. In all these models, however, protection is never the first-best policy. Even when protection could improve welfare, a production subsidy would be more efficient since it avoids the temporary consumption losses associated with protection. In addition, protection may not work if the market failure is due to sector-specific coordination problems, since tariff-induced growth does not necessarily help to solve coordination failures. Finally, just as R&D subsidies are appropriate responses to innovation spillovers, policies to promote entry into new industries are appropriate to deal with information spillovers associated with the discovery of new profitable activities.

While a number of market failures could justify government intervention in theory, one key question is whether IP has worked in practice. The theoretical discussion is followed by a review of the empirical literature on industrial policy in Section 3. One challenge that we face in evaluating the empirical literature is the large gap between the theoretical justification for IP and the quantitative work that has been done to evaluate its "success". Even if we could show that protected sectors grow faster, this is not sufficient evidence to claim that IP is justified from a welfare standpoint.

Despite this shortcoming, we proceed in Section 3 to evaluate three different approaches to measuring the effectiveness of infant-industry protection. The first approach focuses on particular industries that have received protection, such as the steel rail industry in the US and semiconductors in Japan. The few existing studies of this nature suggest that the conditions necessary to generate positive net welfare gains from infant industry protection are difficult to satisfy in developing countries.

A second empirical strategy exploits the variation in productivity growth and different measures of support (including protection and production subsidies) across industries to see whether supported industries exhibit faster growth. The challenge here is that tariffs and quotas are frequently imposed for reasons other than the pursuit of industrial policy. If we cannot identify the motive for protection, then it is difficult to evaluate either the success or failure of IP via trade policy instruments. Generating fiscal revenue, improving terms of trade, and political considerations (rent-seeking) are likely to be just as important as infant-industry considerations in explaining the pattern of trade policy and other measures of support.

Finally, a third approach studies particular countries (e.g., South Korea and Taiwan) and cross-country variation in trade policy and economic growth. While the literature on trade and growth linkages faces many challenging problems, in Section 4 we suggest two general lessons that may be drawn from the voluminous evidence. First, there was no significant relationship in the second half of the twentieth century between average protection levels and growth. Second, there is a positive association between trade volumes and growth. We interpret the lack of a significant association between average tariffs and growth, combined with the strong relationship between trade shares and growth, to suggest that any successful IP strategy must ultimately increase the share of international trade in GDP. The fact that so many countries have been unsuccessful in offsetting the anti-trade bias of their interventions may explain why so many have failed to succeed at IP.

We also review a new set of studies that emphasize the complementarity between trade and FDI reforms and other government policies. These studies suggest that trade liberalization will not generate faster growth unless accompanied by changes in other parts of the economy, such as reducing barriers to new firm entry, encouraging more flexible labor markets, and improving infrastructure. These new studies are consistent with one of the most important new theoretical developments in international trade: the emphasis on heterogeneous firms. The new heterogeneous trade models suggest a new mechanism through which trade affects productivity growth: greater competition forces less productive firms to exit and increases the market share of more productive firms. In this framework, gains from trade cannot be realized when there are barriers to firm exit and expansion, which suggests a need to take into account complementary policies on entry and exit. We finish Section IV with an analysis of whether learning-by-exporting seems to be quantitatively important, and a discussion of the empirical evidence

regarding other mechanisms through which trade policy might affect growth.

Aside from intervening in trade, many developing countries deviate from policy neutrality by introducing tax breaks and other policies to attract foreign direct investment (FDI). While economists are generally skeptical regarding the benefits of intervening in trade, they are much more likely to have interventionist priors when it comes to FDI. Is this pro-interventionist stance with respect to FDI justified? In Section 5, we review the micro studies which have identified a number of important effects of inward foreign investment flows. While most of the empirical literature focuses on productivity spillovers, there is also a growing literature that examines export promotion through foreign investment, input linkages, and labor market effects. We argue that FDI is associated with technology transfer and positive labor market outcomes in developing countries, but that the empirical literature on FDI does not yield sufficient evidence in favor of industrial policy to justify subsidies to foreign investment.

At the end of this survey, we provide some broad suggestion for industrial, trade and foreign-investment policy in developing countries. To preview our conclusions, we find no support for "hard" interventions that distort prices to deal with Marshallian externalities, learning-by-exporting, and knowledge spillovers from FDI. Nevertheless, we still envision an important role for what we refer to as "soft" industrial policy. The goal is to develop a process whereby government, industry and cluster-level private organizations can collaborate on interventions to increase productivity. We suggest programs and grants to help particular clusters by improving the formation of skilled workers, regulation and infrastructure.

2 The Theoretical Justification for Industrial Policy

The textbook model of IP is based on the idea that some sectors or industries exhibit *Marshallian externalities*, which are local externalities that increase with the size of the industry. These externalities can arise through localized industry-level knowledge spillovers, input-output linkages together with transportation costs to ensure that the externalities remain local, and labor pooling (see Marshall, 1920, and Krugman, 1991). Marshallian externalities give rise to geographic agglomeration of industries (e.g., software in

Silicon Valley), which have been emphasized in the literature on economic geography.

The simplest model of IP entails a small-open economy with two sectors, 1 and 2. Sector 1 has constant returns to scale while Sector 2 has Marshallian externalities. The key result is that under some conditions there are multiple equilibria, with the equilibrium with complete specialization in Sector 2 being superior to the one with complete specialization in Sector 1.[1] One could say that the economy has a "latent" comparative advantage in Sector 2 but that a coordination failure prevents it from exploiting this advantage.[2] Since the realization of Marshallian externalities is likely to take some time, it is customary to talk about countries having a "dynamic" comparative advantage (Wade 1990, Amsden 1989) in sectors other than the ones in which they are currently specialized, and to think of industrial policy as the way to undertake the necessary transformation to capitalize on that dynamic advantage. We think of this as the main theoretical justification for infant-industry protection.

The following subsection presents a simple static model that formally captures this idea for an economy facing exogenous international prices. We then move on to endogeneize these prices based on production costs in the rest of the world, and then show how the results extend to a dynamic framework.

If the South does not have a latent comparative advantage in the advanced sectors likely to have Marshallian externalities, is there still a case to be made for an IP that would promote a structural transformation towards those sectors? In Subsection 2.2 we show that there are indeed conditions under which this is the case. In particular, IP makes sense in two scenarios: first, when there are rents associated with the advanced sector, so that its international price is high relative to its cost; and second, when there are inter-industry externalities, so that a large advanced sector increases the economy's productivity across the board.

Marshallian externalities arise as an automatic consequence of the scale of the sector: a sector necessarily experiences an increase in productivity as

[1] Multiple Pareto-ranked equilibria can also arise in a closed economy, although the behavior of prices makes this less likely. This is because as one sector is expanding, the relative price moves against this sector, and this may rule out multiplicity. See Murphy, Shleifer and Vishny (1989).

[2] There are other rationales that have been discussed for industrial policy, including financial market imperfections. We ignore these arguments in this chapter (see Baldwin 1969 for an early criticism, and Pack and Saggi, 2006, for a recent survey).

it becomes larger. As argued by Baldwin (1969), however, the expansion of a sector does not always bring about positive agglomeration externalities. Such agglomeration effects may instead depend on the way in which production is carried out. In other words, externalities may not be intrinsic to sectors, but to the way in which they are organized (Rodríguez-Clare, 2007). In this case, a sectorial reallocation of resources is not enough; import substitution, for example, may allow an economy to expand its manufacturing sector, but production may take place in unsophisticated ways and no "clustering" benefits may materialize. In Subsection 2.3 we present a model where, instead of Marshallian externalities, sectors present *opportunities* for collective action that increases their productivity by a certain amount (which may be different across sectors). If there are no rents (i.e., if international prices perfectly reflect production costs in the North), then the best policy is simply to exploit the opportunities for collective action in the sectors where the economy is specialized. Under more general conditions, we show that sectors that would merit special consideration for IP would be ones that have large opportunities for productivity-enhancing collective action, or that have high world demand relative to the combined size of countries that have achieved such collective action.

In Subsection 2.4 we turn to IP aimed at "diversification." This is something that is often stated as a goal by many countries. We present a simple model where diversification is linked to productivity and argue that if there is a market failure reducing the level of diversification below the optimal one (as in Hausmann and Rodrik, 2003), then a policy of encouraging discovery and diversification would indeed be welfare enhancing.

2.1 Multiple Equilibria and Latent Comparative Advantage

We first present a static model with exogenous prices, and then discuss the implications of the model when prices are determined by production costs in the rest of the world.

2.1.1 Exogenous international prices

There is a small economy, which we call "South," two goods and one factor of production, labor, in fixed supply, L.[3] Good 1 is produced with constant returns to scale (CRS) and no aggregate externalities: a unit of labor produces λ_1 units of good 1. Good 2 is produced with constant returns to scale at the firm level, but there are aggregate externalities, so that labor productivity is:

$$\lambda_2 \left[1 + \alpha Min(\bar{L}, L_2)\right]$$

with $\alpha > 0$ and $\theta \equiv 1 + \alpha\bar{L} > 1$. The term $1 + \alpha Min(\bar{L}, L_2)$ captures Marshallian externalities that are increasing with industry-wide employment, L_2, but that are exhausted once the labor force in a sector reaches the level $\bar{L}$. The term θ can be seen as the maximum benefits of *clustering* in sector 2.[4] We assume that the total labor supply in South is higher than $\bar{L}$, so that if there is complete specialization in good 2 then productivity is $\theta\lambda_2$.

Let p_i^* be the international price of good i and let $p^* \equiv p_2^*/p_1^*$. Let us derive a condition under which there are multiple equilibria, with one equilibrium characterized by complete specialization in good 1 and the other by complete specialization in good 2. We first check that specialization in good 1 is an equilibrium. Letting w denote the wage in South, then $w = p_1^*\lambda_1$ if South is specialized in good 1. The unit cost of producing good 2 in South given that all labor is devoted to production of good 1 (and hence no benefits of clustering are realized) is w/λ_2. Hence complete specialization in good 1 is an equilibrium if and only if $\lambda_1/\lambda_2 \geq p^*$. Similarly, complete specialization in good 2 implies $p_2^* = w/\theta\lambda_2$, and hence this is an equilibrium if and only if $\lambda_1/\lambda_2 \leq \theta p^*$. Thus, there is multiple equilibria if and only if the following

[3] This subsection follows Rodríguez-Clare (2007). Models of multiple equilibria in a small open economy include Okuno-Fujiwara, 1988, Rodríguez-Clare, 1996, Rodrik, 1996, Ciccone and Matsuyama, 1996.

[4] In the traditional model, $\overline{L}$ is infinite, so labor productivity is simply $\lambda_2(1 + \alpha L_2)$. The alternative assumption that these aggregate externalities are bounded is not only more realistic, but also leads to a simpler analysis. Moreover, this assumption allows us to focus on the issue of latent comparative advantage, as opposed to advantages arising from differences in size or scale. For an analysis where scale (but not infant-industry protection) takes center stage, see Ethier (1982), which formalizes the discussion relating to Frank Graham's argument for protection (Graham, 1923). Scale effects could be captured in the model presented here by assuming that $\overline{L}$ is large; in this case small countries could not exhaust the Marshallian externalities even if they specialized completely in industry 2.

condition holds,

$$p^* \leq \lambda_1/\lambda_2 \leq \theta p^* \tag{1}$$

Without loss of generality, in the following discussion we restrict attention to the case in which this condition holds with strict inequalities. If there are multiple equilibria, which equilibrium is better? In the equilibrium with complete specialization in good 1 the wage is $w = p_1^* \lambda_1$, whereas in the other equilibrium we have $w = \theta p_2^* \lambda_2$. If condition (1) is satisfied with strict inequalities then $\theta p^* \lambda_2 > \lambda_1$, so the equilibrium with complete specialization in good 2 is superior.[5]

We will say that South has a *latent comparative advantage* in good i if the opportunity cost of this good given the realization of all Marshallian externalities is lower than the international price.[6] For good 1 this entails $\theta\lambda_2/\lambda_1 \leq 1/p^*$, whereas for good 2 this is $\lambda_1/\theta\lambda_2 \leq p^*$. Thus, condition (1) with strict inequalities implies that South has a latent comparative advantage in good 2. The equilibrium with specialization in good 1 is possible because in this case Marshallian externalities are not realized, and hence the latent comparative advantage of South in good 2 is not what determines the pattern of specialization. Thus, the previous results (i.e., existence of multiple equilibria and the fact that generally the equilibrium with specialization in good 2 is superior to the one with specialization in good 1) can be reinterpreted as saying that a country may be specialized in a sector where it doesn't have a latent comparative advantage, and that in this case a policy that induces the economy to switch to the equilibrium with specialization in the good where there is a latent comparative advantage *could* be welfare enhancing (see discussion below).

Figure 1 illustrates the previous results. The curve labeled PPF represents the Production Possibilities Frontier for South, which is convex when $L_2 < \bar{L}$ (or $Q_2 < \lambda_2 \theta \bar{L}$) and becomes linear when $L_2 \geq \bar{L}$ (or $Q_2 \geq \lambda_2 \theta \bar{L}$). The curve labeled PPF_{NC} is the hypothetical Production Possibilities Frontier when there are no ME (i.e., $\alpha = 0$), given simply by a line with slope

[5] The result of multiple Pareto-ranked equilibria can be converted into one of development traps by introducing proper dynamics in the model (see Krugman, 1991 and Matsuyama, 1991). Under some conditions, the economy may be specialized in the good in which it doesn't have latent comparative advantage, and there may be no equilibrium taking it to specialization in the other good. Government intervention in this case would require more than simple coordination to select the good equilibrium.

[6] If Marshallian externalities take time to be realized, then one could talk about a *dynamic comparative advantage*. See Redding (1999).

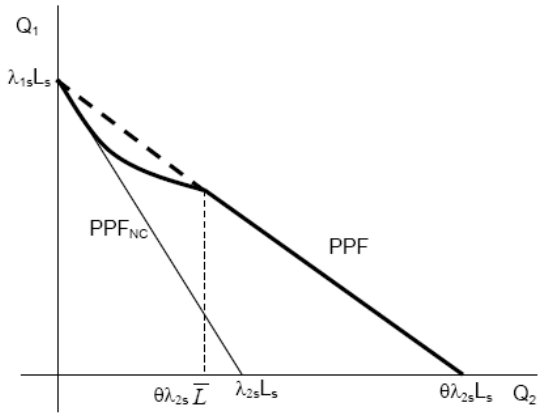


Figure 1: Marshallian Externalities and Multiple Equilibria

λ_1/λ_2, as in the standard Ricardian model. Note that the slope of the PPF is the same as the slope of PPF_{NC} at the corner where there is complete specialization in good 1. Thus, if the international relative price of good 2 (i.e., p_2^*/p_1^*) is lower than λ_1/λ_2 there is an equilibrium with complete specialization in good 1, whereas if p_2^*/p_1^* is higher than the slope of the PPF along its linear segment - namely, $\lambda_1/\theta\lambda_2$ - then there is an equilibrium with complete specialization in good 2. Clearly, then, if (1) is satisfied, there are multiple equilibria, with the equilibrium with specialization in good 2 delivering a superior consumption possibilities frontier for South.

The standard case for infant industry protection or IP can now be stated simply by saying that if the South is specialized in good 1, then a high enough tariff would lead this economy to satisfy its own consumption of good 2. This would allow the South to realize the benefits of the Marshallian externalities associated with this sector, and thereby shift the equilibrium towards complete specialization in good 2.[7] At that point the tariff would no longer be needed, and the economy could maintain free trade.

Sauré (2007) presents an interesting and novel argument for why protection may fail to generate the results predicted by this model. He assumes

[7] We assume here that the South is sufficiently large that under autarky it would have $L_2 \geq \bar{L}$.

that goods 1 and 2 are tradable inputs into the production of a final non-tradable good via a "modern technology." The key assumption is that the final good can also be produced directly from labor with a "traditional technology" which exhibits CRS (no Marshallian economies). Under some conditions protection makes the modern technology unprofitable because of the increase in the price of input 2. Thus, rather than increasing production of the good with Marshallian externalities, protection leads to the contraction of the whole modern sector and a reallocation of resources towards the traditional sector.

2.1.2 International prices determined in North

The previous discussion takes international prices as exogenous. But prices are (at least in part) determined by productivity levels in the rest of the world. One would imagine that rich countries are already enjoying the lower costs associated with clustering in sector 2, so these lower costs would be reflected in p^*. Thus, for a small country to have a latent comparative advantage in sector 2, it must have some deep parameters that confer it such an advantage. To see this, imagine now that there are two countries, North and South, which may differ in the productivity parameters, λ_1 and λ_2, so that there are exogenous international productivity differences (independent of Marshallian externalities) in the production of both goods 1 and 2. Imagine further that South is small, so that prices are determined in North as if it was a closed economy. Choosing labor in North as the numeraire, international prices are simply given by the North's unit labor requirements. Assuming that in equilibrium $L_{2N} \geq \bar{L}$ then $p_1^* = 1/\lambda_{1N}$ and $p_2^* = 1/\theta\lambda_{2N}$, so $p^* = \lambda_{1N}/\theta\lambda_{2N}$. Note that the benefits of clustering are reflected in a lower international relative price of good 2. This will be important in the analysis that follows.

Imagine first that there are no Ricardian productivity differences, $\lambda_{ji} = 1$ for all $j = S, N$ and $i = 1, 2$. Using (1) it is easy to confirm that there are multiple equilibria in South (since $p^* = 1/\theta$ then condition (1) is $1/\theta \leq 1 \leq 1$), but since the second part of (1) is satisfied with equality, then the wage is the same in both equilibria. Thus, although there are multiple equilibria, the wage is not higher in the equilibrium with specialization in good 2. This is because even though the economy benefits from clustering in this equilibrium, this is exactly compensated by the lower price of this good, which in turn arises from the higher productivity in North derived from clustering.

The equilibrium with specialization in good 2 may be superior to the

one with specialization in good 1 if we allow for exogenous productivity differences. In particular, the equilibrium with specialization in good 2 will be superior if the South has a latent comparative advantage in the good subject to clustering. To see this, drop the assumption that $\lambda_{ji} = 1$ for all j, i, and assume instead that

$$\lambda_{2S}/\lambda_{1S} > \lambda_{2N}/\lambda_{1N} \tag{CA}$$

The condition for multiple equilibria (i.e., condition (1)) is now (using $p^* = \lambda_{1N}/\theta\lambda_{2N}$)

$$\lambda_{1N}/\theta\lambda_{2N} \leq \lambda_{1S}/\lambda_{2S} \leq \lambda_{1N}/\lambda_{2N} \tag{2}$$

The second inequality is satisfied given (CA), so there is always an equilibrium with specialization in good 2. The first inequality (needed for there to be an equilibrium with specialization in good 1) is satisfied if and only if

$$\frac{\lambda_{2S}/\lambda_{1S}}{\lambda_{2N}/\lambda_{1N}} \leq \theta \tag{3}$$

That is, the South's comparative advantage in sector 2 must be weaker than the benefits of clustering.

The analysis here is exactly as above, with condition (2) replacing condition (1). Condition (CA) is necessary for South to have a latent comparative advantage in good 2, and this is necessary for the wage with specialization in good 2 to be higher and for IP to make sense for South.

An important point to note is that for the gains from IP to be large we need South to have a strong latent comparative advantage in good 2. But then condition (3) implies that Marshallian externalities must also be high for there to be multiple equilibria. We can conclude that *IP generates large gains only if the sector that would be promoted exhibits both a strong latent comparative advantage and large externalities.*

One can enrich the model to generate some additional implications. For example, if sector 2 is intensive in physical and human capital relative to sector 1, then if South is specialized in 1 this goes together with low levels of both types of capital and a lower level of TFP than if it were specialized in sector 2 (Ciccone and Matsuyama, 1996, Rodríguez-Clare, 1996). A policy to shift resources towards sector 2 would then generate endogenous accumulations of capital, as observed in East Asian countries. In other words, some LDCs may have low capital stocks as well as low TFP as a consequence of not exploiting their latent comparative advantage.[8]

[8] One problem with this idea as a way to think about income differences across countries

2.1.3 Dynamic externalities

Here we extend the model to allow for dynamic Marshallian externalities, as in Bardhan (1970), Krugman (1987), Lucas (1988), Redding (1999) and Melitz (2005). To do so, we assume that productivity in sector 1 in country i is λ_{1i}, just as above, whereas productivity in sector 2 in country i at time t is now $A_{it}\lambda_{2i}\left[1+\alpha Min(\bar{L}, L_{2it})\right]$. Letting $a_{St} \equiv \max\{A_{St}/A_{Nt}, 1\}$ and $a_{Nt} \equiv \max\{A_{Nt}/A_{St}, 1\}$, we assume that A_{it} grows thanks to both learning by doing (which happens if country i has a cluster in sector 2, i.e. $L_{2it} > 0$) and international spillovers (which happens if $a_{it} < 1$). Formally, we assume that

$$\dot{A}_{it} = (g/\bar{L})\min(\bar{L}, L_{2it})A_{it} + \varepsilon(1-a_{it})A_{it}$$

where $\varepsilon > g > 0$. Productivity increases caused by dynamic externalities in one country eventually diffuse to the other country even if there is no cluster there. Thus, in this model clusters are important to generate knowledge but are not critical to benefit from knowledge spillovers.

Note that if the North has a cluster but the South does not, then $\dot{A}_{St} = \varepsilon(1-a_{St})A_{St}$. There are "benefits of backwardness," in the sense that a lower relative productivity in South (i.e., lower a_{St}) leads to a faster rate of productivity growth. This implies that given $\varepsilon > g$ there is a steady state productivity gap $A_{St}/A_{Nt} = \hat{a}$ given implicitly by $g = \varepsilon(1-\hat{a})$: if $a_{St} < \hat{a}$ ($a_{St} > \hat{a}$) then a_{St} increases (decreases) towards $\hat{a}$. For future reference, note that the productivity of North relative to South in this steady state is $(\lambda_{2N}/\lambda_{2S})\theta/\hat{a}$: the first term captures pure Ricardian productivity differences, whereas the second and third terms capture the impact of static and dynamic benefits of clustering, respectively. Starting from such a steady state, if South acquires a cluster in sector 2, so that now $L_{2St} \geq \bar{L}$, then there will be full convergence as a_{St} increases from $\hat{a}$ towards 1.

As before, assume that prices are wholly determined in North. Then $p_1^* = 1/\lambda_{1N}$ and $p_{2t}^* = 1/A_{2Nt}\theta\lambda_{2N}$, and assume that condition (CA) holds. Focusing on the South, complete specialization in 1 is a steady state equilibrium if

$$\frac{\lambda_{2S}/\lambda_{1S}}{\lambda_{2N}/\lambda_{1N}} \leq \theta/\hat{a} \tag{4}$$

On the other hand, complete specialization in good 2 is necessarily a steady state equilibrium (given condition (CA)). Thus, there are multiple steady

is that it would imply that poor countries have a lower physical capital share, which is not consistent with the data (see Gollin, 2002).

states if and only if condition (4) is satisfied. It can be readily verified that the steady state with specialization in good 2 entails a higher wage for South than the steady state with specialization in good 1. This is because condition (CA) implies that South has a latent or "dynamic" comparative advantage in good 2.[9]

Imagine that this condition is satisfied and that the system is in steady state with South completely specialized in good 1. Is there an equilibrium in which South moves to the steady state with specialization in good 2? If South becomes specialized in good 2 then it realizes the static externalities, but it will take some time for it to catch up to the North in terms of productivity (i.e., $a_{St} < 1$ for some time). During this period, specialization in good 2 is an equilibrium if

$$\frac{\lambda_{2S}/\lambda_{1S}}{\lambda_{2N}/\lambda_{1N}} \geq 1/a_{St}$$

This implies that if

$$1/\hat{a} \leq \frac{\lambda_{2S}/\lambda_{1S}}{\lambda_{2N}/\lambda_{1N}} \leq \theta/\hat{a}$$

then there are multiple steady states, and also an equilibrium in which simply South switches from specialization in good 1 to specialization in good 2 and eventually reaches the steady state with complete specialization in good 2. The government could achieve this switch with trade protection for an infinitesimally short time, and the gains would necessarily outweigh any associated costs (see below).

On the other hand, if

$$\frac{\lambda_{2S}/\lambda_{1S}}{\lambda_{2N}/\lambda_{1N}} < 1/\hat{a}$$

then this is no longer the case. There would need to be temporary protection until a_{St} increases from $\hat{a}$ to a level a' defined implicitly by

$$\frac{\lambda_{2S}/\lambda_{1S}}{\lambda_{2N}/\lambda_{1N}} = 1/a'$$

After that, complete specialization in good 2 would be an equilibrium for South. Eventually the system would reach the steady state with $a_{St} = 1$.

[9] Formally, we would say that a country has a latent or dynamic comparative advantage in a good if its opportunity cost *given the realization of all static and dynamic Marshallian externalities* is lower than the international price.

2.1.4 Discussion

The simple model presented here captures the notion that temporary protection may induce an economy in a bad equilibrium to switch towards the equilibrium where specialization is according to its latent or dynamic comparative advantage. Of course, this is nothing more than the classic case for infant-industry protection, where policy is supposed to turn a latent comparative advantage into an effective one.[10] Such a policy would be welfare enhancing provided it passes both the Mill and Bastable tests: the Mill test is that the protected sector can eventually survive international competition without protection, whereas the Bastable test is more stringent in requiring also that the discounted future benefits compensate the present costs of protection (see Kemp, 1960, and Corden, 1997). In the model above, infant-industry protection passes the Mill test if and only if the South has a latent comparative advantage in the protected sector. The Bastable test requires that the discounted gains from IP compensate the temporary consumption loses associated with protection during the period in which the economy is generating the (dynamic) productivity gains associated with clustering. This is the period when a_{St} is increasing from $\hat{a}$ to a'. Bardhan (1971), Redding (1999) and Melitz (2005) - among others - explore the conditions on the learning process under which the benefits of protection justify these initial losses. Bardhan (1970) and Melitz (2005) explore the optimal way in which protection should be granted.

Of course, protection is only a second-best policy to deal with the presence of Marshallian externalities. A production subsidy would be more efficient, as it would avoid the temporary consumption losses mentioned above. The whole discussion of infant-industry protection is based on the presumption that a production subsidy is simply not feasible, either for fiscal, political or practical considerations (see Section 3). If this were not the case, then the analysis would be quite simple: provide a (Pigovian) subsidy such that the marginal subsidy is equal to the marginal externality. Naturally, if the source of the externality is not production but some more specific activity

[10] John Stuart Mill (1848, reference 1909) is generally credited for being the first to express this idea in a clear and simple way, although it was Friedrich List (1885) who vigorously argued for the adoption of infant-industry protection of manufacturing in European countries. See Corden (1997) for a discussion of the different arguments for and against infant-industry protection, and Irwin (1996) for an excellent treatment of its intellectual history.

(e.g., R&D) then the subsidy should be directed there.

The condition that the South have a non-exploited latent comparative advantage to justify protection is special to the simple Ricardian model we presented, where the production possibilities frontier (PPF) is linear and there is a tendency for complete specialization. If the PPF is strictly concave and international prices are such that under free trade the economy is diversified, then the presence of Marshallian externalities in the import competing sector implies that a small tariff would necessarily be welfare increasing. But this kind of "marginal intervention" is not what people commonly associate with infant-industry protection.

Another possibility that arises with a strictly concave PPF is multiple equilibria where the bad equilibrium has a low (but positive) production level, whereas the good equilibrium has a higher production level but not enough for any of this production to be exported. Even if the economy does not have a latent comparative advantage, temporary protection may be welfare enhancing in this case as long as the Mill and Bastable tests are satisfied.

Although it is a special result to the simple Ricardian model presented here, the result that a latent comparative advantage is necessary for infant-industry protection seems useful to guide policy discussions in practice. First, in all cases in which infant-industry protection has supposedly been successful, the infant sector eventually generates significant exports. It is simply hard to imagine otherwise. Second, if there are resource constraints that prevent the sector from becoming large, then it is likely that the benefits of IP would be small and perhaps the associated costs and risk would not be justified. For this reason, in the rest of this section we restrict attention to the Ricardian model (linear PPF).

2.2 Industrial Policy without Latent Comparative Advantage

Can it be advisable for South to run a policy to promote specialization in a good with Marshallian externalities (i.e., good 2 in the model above) in spite of *not* having latent comparative advantage in that sector? For this analysis and the rest of this section we again restrict attention to the simpler static analysis.

2.2.1 Sector-level rents

Imagine that prices are determined not in a single economy, but in a collection of economies. In particular, assume that North is partitioned into two regions, N_1 and N_2, with labor quantities L_N^1 and L_N^2. Everything else is as above. Without loss of generality, assume that region N_2 is the one that will produce good 2. If L_N^2 is sufficiently large relative to the world's demand for good 2 then it will not be completely specialized in that good, in which case prices will be determined by technology levels (inclusive of clustering effects), so that $p^* = \lambda_{1N}/\theta\lambda_{2N}$, just as in the previous case. But if L_N^2 is small relative to the world demand for good 2, then in equilibrium one can have

$$\lambda_{1N}/\lambda_{2N} > p^* > \lambda_{1N}/\theta\lambda_{2N} \tag{5}$$

In contrast to what we have with an integrated North, here p^* can be strictly higher than $\lambda_{1N}/\theta\lambda_{2N}$. The difference can be interpreted as the "rents" associated with good 2. To capture this, let

$$R \equiv \frac{p^*}{\lambda_{1N}/\theta\lambda_{2N}}$$

Condition (5) can now be stated as

$$\theta > R > 1 \tag{6}$$

Consider again a "small" South, which takes international prices as given. The condition for multiple equilibria is again given by (1), with p^* satisfying (5). This can be written as

$$R/\theta \leq \frac{\lambda_{1S}/\lambda_{2S}}{\lambda_{1N}/\lambda_{2N}} \leq R \tag{7}$$

We are interested in the case where South does not have a latent comparative advantage in good 2, or

$$\lambda_{1S}/\lambda_{2S} > \lambda_{1N}/\lambda_{2N} \tag{8}$$

In this case, the LHS inequality in (7) is always satisfied (given (6)), while the RHS inequality, which is necessary for specialization in good 2 to be an equilibrium, is satisfied if $R > CA$, where $CA \equiv \frac{\lambda_{1S}/\lambda_{2S}}{\lambda_{1N}/\lambda_{2N}}$ is a measure of comparative advantage in South in good 1. In other words, there is multiple

equilibria in South if its comparative advantage in good 1 is smaller than the rents associated with international prices. Moreover, just as in the previous cases, the equilibrium with specialization in the good with Marshallian externalities sustains a higher wage.[11] This result is reminiscent of the literature on strategic trade policy, where increasing returns and imperfect competition leads to the existence of rents which governments try to capture via trade policy.

An alternative way to get a similar result is by assuming the existence of a wage premium in sector 1.[12] To see this, assume again that North is a single integrated region, but with a wage premium in sector 2, so that $w_2 = Rw_1$. Then it is easy to verify that $p^* = R\lambda_{1N}/\theta\lambda_{2N}$, which is the same as above.[13],[14]

2.2.2 Inter-industry externalities

We have so far focussed on intra-industry externalities. Consider instead aggregate externalities, so that all sectors in the country benefit from the externalities realized in a sector (see Succar, 1987, Young, 1991, and Greenwald and Stiglitz, 2006).[15] Assume that now productivity in good i in country j

[11] Another way to think about rents is if South were no longer a small economy. Consider Figure 1 again and imagine that there are no productivity differentials between South and North. Imagine further that these two regions have equal size, and that demand for good 2 is sufficiently high that the equilibrium entails one country fully specialized in good 2 and the other fully specialized in good 1. Then, if condition (1) is satisfied, the country that specializes in good 2 is better off than the country that specializes in good 1.

[12] Yet another way to have rents would be through the existence of pure profits, as in the literature on "strategic trade policy" (Brander and Spencer, 1983, Eaton and Grossman, 1989).

[13] We have assumed here that there is no wage premium in South. If there were a wage premium in South of equal magnitude as in North, then in the absence of a latent comparative advantage in good 2, there would not be multiple equilibria, but it could be advisable for South to implement a policy to specialize in sector 2. This would no longer be a case of Marshallian externalities and infant-industry protection, but rather a standard application of the theory of domestic distortions and trade policy.

[14] One difference with the case analyzed above, where rents arise from lack of FPE, is that with wage premia we no longer have the restriction that $R < \theta$. The reason is that now the opportunity cost of good 2 given that region is specialized in good 1 is $R\lambda_{1N}/\lambda_{2N}$, and we need this to be higher than p^*, which is possible even if $\lambda_{1N}/\lambda_{2N} < p^*$. Note that in this case then there is no equilibrium with specialization in good 1 in South.

[15] Perhaps the most important type of inter-industry externalities are generated by industries that supply specialized inputs that are used intensively by firms in many other

is

$$\lambda_{ij}\left[1+\alpha_i Min(\bar{L},L_{2j})\right]$$

with $\alpha_1 < \alpha_2$, so that intra-industry externalities are stronger than inter-industry externalities. Let $\theta_i \equiv 1+\alpha_i\bar{L}$ and note that $\theta_1 < \theta_2$. We return to the case of FPE in North with no rents, so that $p_i^* = 1/\theta_i\lambda_{iN}$, and assume that South has a latent comparative advantage in good 1. It is readily verified in this case the only equilibrium in South entails specialization in good 1.[16] But specialization in good 2 implies $w = \theta_2\lambda_{2S}p_2^* = \lambda_{2S}/\lambda_{2N}$, while specialization in good 1 implies $w = \lambda_{1S}p_1^* = \lambda_{1S}/\theta_1\lambda_{1N}$. The first is higher than the second if and only if

$$1/\theta_1 < \frac{\lambda_{2S}/\lambda_{1S}}{\lambda_{2N}/\lambda_{1N}}$$

If this is satisfied, then forcing the economy towards specialization in good 2, even if this is not an equilibrium, is better than staying in the equilibrium with specialization in good 1. In this case, the losses from going against comparative advantage by specializing in sector 2 are dominated by the gains associated with the economywide externalities generated. This may be one way of interpreting the argument in the late 1980s in favor of protecting the semiconductor industry in the United States (see Borrus, Tyson and Zysman, 1986).

2.3 Industrial Policy as Sector-Specific Collective Action

We have so far focused on Marshallian and inter-industry externalities as reasons for IP. A more general conceptual framework for thinking about IP is the existence of coordination failures at the industry or sector level. Of course, coordination failures arise in the presence of Marshallian externalities. The difference is that the distortions associated with these externalities (at least as modeled above) disappear when the sector gets sufficiently large,

sectors. According to Wade (1990), this kind of reasoning was quite important in Taiwan, where the government promoted several sectors that were deemed to provide critical inputs for many other industries. See Noland and Pack (2003) disagree with this view.

[16] The condition for specialization in good 1 to be an equilibrium is $\frac{\lambda_{2S}/\lambda_{1S}}{\lambda_{2N}/\lambda_{1N}} < \frac{\theta_2}{\theta_1}$, which is clearly satisfied given $\frac{\lambda_{2S}/\lambda_{1S}}{\lambda_{2N}/\lambda_{1N}} < 1$ together with $1 < \frac{\theta_2}{\theta_1}$. On the other hand, specialization in good 2 implies that $w/\theta_2\lambda_{2S} = p_2^*$. This is an equilibrium if $w/\theta_1\lambda_{1S} > p_1^*$, or $\frac{\lambda_{2S}}{\lambda_{1S}} > \frac{\lambda_{2N}}{\lambda_{1N}}$, which cannot be satisfied if South has CA in good 1.

whereas this is not the case with other types of coordination failures. For example, in Rodríguez-Clare (2007) externalities arise only when "modern" technologies are used in a sector. Thus, even sectors that are seen as "advanced" in developed countries can behave as backward sectors when they operate in LDCs, and hence fail to generate any externalities. This captures the idea that what matters for productivity is not "what you produce, but how" (Porter, 1998, De Ferranti et. al., 2001). In these circumstances, a sector can expand and still fail to experience an increase in productivity.[17] Protection or export subsidies would fail, and other policies would be called for.[18]

The existence of coordination failures implies that collective action at the sector level may lead to productivity gains. A concrete example of collective action is the eradication of food and mouth disease in Uruguay's cattle industry, which generated enormous benefits by allowing the industry to export beef to the United States (see Hausmann, Rodríguez-Clare and Rodrik, 2005). Simply providing a production or export subsidy to the cattle industry would not have solved the problem. A specific policy to deal with the coordination failure associated with strong externalities was necessary. Another example is the case of flower exports from Ecuador (Hernández et. al. 2007). Several attempts to export flowers in the 1960s and 70s failed in part because of the lack of reliable air transport to the main destinations. A key difference in the 1980s was an effort by the association of flower exporters, EXPOFLORES, to convince the government and the national airline to set up the required number of cargo flights for this activity. Thanks in part to this effort, the value of flower exports boomed from less than half a million dollars in 1984 to more than $400 million in 2006.[19]

[17] This may explain the existence of cases of geographic concentration of sectors that failed to experience significant agglomeration economies(e.g., concentrations of footwear and textile producers). Perhaps these are cases of clusters that failed to achieve Marshallian externalities (see Altenburg and Meyer-Stamer, 1999).

[18] An appropriate policy could be to subsidize production but only to the extent that it is done using modern technologies.

[19] Another example, also from Ecuador, concerns the development of new exports of broccoli and mangoes, where finding the best seeds and meeting international phytosanitary standards presented producers with significant coordination problems. As stated by Hernández et. al. (2007), collective action fostered and implemented by several private, public and mixed agencies was important in dealing with such problems and in facilitating the development of these new sectors. Similar cases are documented for Chile in Agosín and Bravo-Ortega (2007) and for several countries in Chandra and Kolavalli (2006).

2.3.1 A simple model

We now want to explore a model where policy can induce higher productivity in a sector through some kind of industry-level collective action, and where prices are determined in a collection of economies (not only in "the North"), so that there may be rents. The goal is not to model the specifics of collective action, but rather to examine the conditions under which this may increase a country's income level.

There are N countries, indexed by j. Labor is the only factor of production, and is available in total quantity L_j in country j. There are M industries indexed by m. There are opportunities for collective action in each industry. Collective action increases productivity in industry m by the factor x_m; otherwise, productivity is one in all industries in all countries. We refer to x_m as the level of *complexity* in industry m, since it seems reasonable to expect that more complex industries will benefit more from collective action. A country that has achieved high productivity in industry m thanks to collective action will be said to have HP (for high productivity) in that industry. Let k_{jm} be the indicator function for whether country j has HP in industry m, and assume $\sum L_j = 1$ so that L_j is also the share of worldwide labor living in country j. Then $s_m \equiv \sum_j k_{jm} L_j$ is the share of labor in countries with HP in industry m. Also, country $j's$ productivity in industry m can be written as $\hat{x}_{jm} \equiv (1 - k_{jm}) + k_{jm} x_m$. Preferences are Cobb-Douglas, with a share v_m devoted to industry m, and $\sum v_m = 1$. Thus, we can think of v_m equivalently as the "size" of industry m, or the extent of the world's demand for its output.

The model described thus far is a Ricardian model with N countries and M industries, where productivity can be either low or high in each industry. The equilibrium is easy to describe: it consists of a set of wages, w_j, prices, p_m, and an allocation, L_{jm}, for $j = 1, ..., N$ and $m = 1, ..., M$ such that for all j and m the following conditions hold: $w_j \geq \hat{x}_{jm} p_m$ and if $L_{jm} > 0$ then $w_j = \hat{x}_{jm} p_m$ (zero profits), and $p_m \sum_j \hat{x}_{jm} L_{jm} = v_m \sum_j w_j L_j$ (i.e., the value of sales of m equals total expenditures on m) for all m.

It is useful to describe an equilibrium without rents. Choosing labor as the numeraire, this entails $w_j = 1$ for all j and $p_m = 1$ if $s_m = 0$ and $p_m = 1/x_m$ if $s_m > 0$; it requires that for each industry either no country has HP or there are enough countries (adjusting for their size) with HP that the large supply drives the price to its marginal cost with unitary wages.[20]

[20] Formally, if $s_m > v_m$ for all m then there is an equilibrium with $w_j = w$ for all j. To

Note that in this case a country that does not achieve HP in any industry would still enjoy the same wage as other countries. We can think of this as a case in which Factor Price Equalization (FPE) holds.

Rents arise when s_m is small relative to v_m. For example, imagine an equilibrium where $s_m = 0$ for all $m \neq 1$, and only country 1 has HP in industry 1. Then $w_j = 1$ for $j = 2, ..., N$ while $w_1 > 1$ if and only if $v_1 > s_1$: there are rents in industry 1 (i.e., the price of industry 1 is higher than the marginal cost at unitary wages, $p_1 > 1/x_1$).[21]

Industries differ with respect to three variables: complexity (measured by x_m), size (measured by v_m), and the share of people in the world that live in countries that have HP (measured by s_m). We will refer to the later as "prevalence," since it measures the extent to which HP is widespread across the world in an industry. The previous result suggests that industries will have rents if they are large relative to their prevalence. Apart from this result, one can learn more from this model only by considering special cases. Instead of doing this, we introduce some additional assumptions to "smooth out" the kinks in the Ricardian model and obtain more general results.

Assume that each industry is composed of a continuum of goods with varying productivity levels. Preferences remain Cobb-Douglas, but now with equal shares across all goods. Thus, assuming that industry m has a measure v_m of goods, then (as above) expenditures on industry m are v_m with $\sum v_m = 1$. (Note that it is natural to think of v_m as the "size" of industry m because it measures both the share of total expenditures devoted to this industry and the measure of goods belonging to that industry.) More importantly, we assume that productivity differs across goods *within an industry* as in Eaton and Kortum (2002). Specifically, productivity for any particular good in sector m in country j is $\hat{x}_{jm}z$, where $\hat{x}_{jm}$ is as above and z is an additional productivity that is independently drawn from the Fréchet distribution with

see this, simply assume that $w_j = 1$ all j, and $p_m = 1/x_m$, and $L_{jm} > 0$ only if $k_{jm} = 1$. We only need to check that $(1/x_m)\sum_j x_m L_{jm} = v_m$ with $\sum_j L_{jm} = v_m$ holds for all m. One can choose L_{jm} in such a way that this holds as long as $s_m \geq v_m$ all m.

[21] The equilibrium could have goods in industry 1 produced by both country 1 and other countries, in which case it is obvious that $w_1 > 1$. Otherwise, if country 1 is the only country with positive production in industry 1, then the equilibrium condition $p_1 L_1 x_1 = v_1 (1 - L_1 + w_1 L_1)$ together with $p_1 x_1 = w_1$ and $s_1 = L_1$ imply that $w_1 = v_1(1 - s_1)/s_1(1 - v_1)$, hence $v_1 > s_1$ implies $w_1 > 1$. If $s_1 = L_1 > v_1$ then $w_1 > 1$ cannot be sustained, because country 1 cannot specialize completely in the good in which it has a superior productivity.

parameters T_j and ϕ, i.e. $\Pr_j(z \leq Z) = \exp[-T_j z^{-\phi}]$.[22] This distribution has sound microeconomic foundations (see Eaton and Kortum, 2001), but understanding those foundations or its several convenient properties is not important for our purposes here; it is sufficient to know that a higher T_j implies better productivity draws for country j (on average).

Since each good is infinitesimally small and there are no transportation costs, then each good will be supplied to the whole world by the country with the lowest cost. If we consider a particular good in industry m with productivity draws $(z_{1m}, z_{2m}, ..., z_{Nm})$ in countries $(1, 2, ..., N)$ then this good will be supplied by country $j = \arg\min_l \{w_l/\hat{x}_{lm} z_{lm}\}$. Eaton and Kortum (2002) show that a country with wage w_j and productivity parameter $\hat{x}_{jm}$ will capture a share

$$D_{jm} = \frac{(w_j/\hat{x}_{jm})^{-\theta} T_j}{\sum_l (w_l/\hat{x}_{lm})^{-\theta} T_l} \tag{9}$$

of total sales in industry m. A country with a lower T_j, a higher w_j, or a lower $\hat{x}_{jm}$ will capture a smaller market share in industry m. Contrary to the standard Ricardian model, however, a country will have positive production in all industries because it will always have a few goods within any industry where its productivity draws are very high. Letting $Y = \sum w_j L_j$ denote worldwide income, then the trade balance conditions are $\sum_m D_{jm} v_m Y = w_j L_j$ (value of sales equal value of purchases for country j). These conditions determine the equilibrium wages $w_1, ..., w_N$.

How is the wage in a country affected by acquiring HP in an industry? If a country had a choice, where should it concentrate its efforts to achieve collective action?[23] These are key questions for IP. Note that we have assumed that there are no deep sources of comparative advantage, so this would not be an issue in this choice. Then it seems reasonable that countries would want to focus their efforts in industries that have higher complexity, are larger (or have higher demand), and have a lower prevalence: higher complexity means that there is more to gain from collective action, while larger demand combined with low prevalence implies higher rents. Under some conditions, one

[22] To simplify the discussion, we assume that $T_j = L_j$ for all j. Otherwise, countries with a higher ratio T_j/L_j would tend to have higher wages for reasons that don't relate to IP (although see next subsection).

[23] If the costs of collective action differ across industries, then this clearly would have to be taken into account in this choice. To simplify the analysis, we assume that the cost of achieving collective action is included in the x_m.

can in fact prove this result. In particular, assume that countries 1 and 2 are identical except that they have HP in industries 1 and 2, respectively, with no HP in the rest of industries (i.e., country 1 has HP only in industry 1 and country 2 has HP only in industry 2). Then one can show that if $\hat{x}_{j1} = \hat{x}_{j2}$ for all $j = 3, ..., N$ then the wage in country 1 is higher than in country 2 if $x_1 > x_2$ or if $v_1 > v_2$. Also, assuming that $x_1 = x_2$ and $v_1 = v_2$, then $w_1 > w_2$ if $s_1 < s_2$ (see Appendix).[24]

We have assumed thus far that there are no differences in industry-level productivity across countries. If this were not the case, then it is clear that a country may want to go against its latent comparative advantage and specialize in goods with combinations of high complexity, high demand and low prevalence. Thus, this model may be suitable to think about IP, although it is important to note that trade protection is not an effective policy in this framework.

2.3.2 Relation of the model to some recent contributions

We now show how to place some recent arguments for IP in the context of this simple analytical framework. Hausmann, Hwang and Rodrik (2006) argue that the varied economic performance of different countries is partly explained by the goods that they produce. Other things equal (including physical and human capital stocks), countries that specialize in what they call "rich country goods" are richer. Their explanation is that such goods provide more opportunities for learning by doing (similar to Young, 1991) and for technological and institutional upgrading that ultimately benefits the whole economy.

The model presented here can capture this notion in a slightly different way. In this model we may talk about "rich country industries" as ones that are more complex, have higher worldwide demand, or exhibit lower prevalence. Countries that achieve HP in these industries would be able to sustain higher income levels, and getting there would entail higher growth rates.

[24] One could imagine a situation in which countries understand this model and implement IP to maximize their income. If collective action had no cost, then obviously all countries would simply achieve HP in all industries. But imagine that collective action is costly. In the resulting equilibrium sectors with higher complexity and/or larger demand would be matched by high prevalence in such a way that the return to collective action would be the same in all sectors.

Hausmann and Klinger (2006) argue that goods are connected, so that productivity in one good would be higher if the country has already achieved HP in a related good. This has similar implications as inter-industry externalities (think of "industries" as "goods"). For example, coming back to the role of specialized inputs, if such inputs exist for one good, this would also help in the production of a similar or related good. Hausmann and Klinger show that some goods are connected to many other goods, while other goods are relatively isolated. They think of the space of goods as a forest, with each good being represented by a tree, and talk about how this forest is more dense in some areas. Hausmann and Klinger (2006) and Hausmann and Rodrik (2006) suggest that if a country could choose, it would want to locate in the denser parts of the forest.

The idea that there are regions in the forest that are more dense is captured in the model above by having industries differ in their size or worldwide demand. The suggestion that countries in dense part of the forests are better off corresponds to the result above that countries are better off if they manage to achieve HP in an industry with a high measure of goods, v_m, since this corresponds to high demand. But the model reveals a weakness of this notion: industries with high demand would not be attractive if they also have high prevalence. Returning to the forest metaphor, being in a dense part of the forest would not be better if this is also more crowded. For example, although the electronics industry may be a "highly connected area" of the forest, there may also be many countries (and large ones, e.g. China) participating in this area. In principle, it could be better for a country to remain in an isolated but relatively uncongested part of the forest.

The measure of the "income level" of an industry developed by Hausmann, Hwang and Rodrik (2006) takes this into account: an industry with high prevalence would exhibit low prices and would thus be classified as one with a lower income level. Thus, in principle, this measure may be seen as a reasonable way to guide countries in choosing industries that are ideal for productivity-enhancing collective action. Unfortunately, however, this may be a noisy measure of the relevant notion needed for IP because it may be capturing capital (physical, human, or knowledge capital) intensity, which leads countries with good conditions for capital accumulation to produce and export these goods. In other words, if there is an exogenous variation in conditions for capital accumulation across countries, and if goods differ in their capital intensity, then rich countries will tend to produce and export capital intensive goods, and this will have nothing to do with industry-specific

collective action and IP. The same association between rich countries and certain sectors may arise because of an exogenous variation in the quality of institutions. For example, if rich countries have institutions that are conducive to capital market development, then they would tend to specialize in goods that rely heavily on outside capital (Manova, 2006). If one could somehow adjust Hausmann, Hwang and Rodrik's measure to isolate the income correlation of goods that is *not* explained by capital intensity or exogenous variation in institutions, then this could be a useful measure for IP. In particular, countries could consider inducing collective action in sectors with a high "adjusted income level."

2.4 Self-discovery and diversification

The notion of IP that we have emphasized so far is that there are "special industries," and that countries should aim to reallocate resources to those industries. An alternative idea that we now explore is to think of a policy to increase diversification. This has been a particular concern in countries that specialize in natural-resource intensive industries (see De Ferranti, 2001, and CAF, 2007, for recent treatments focusing on Latin America). Diversification could be desirable as a way to reduce volatility, or as a way to increase productivity. Here we focus on the later.

To think about the connection between diversification and productivity, consider the Eaton and Kortum (2002) model of trade. As explained above, Eaton and Kortum model productivities as being drawn from a distribution that is common across countries except for a technology parameter T. This technology parameter determines the location of the productivity distribution: countries with a higher T have "better" distributions in the sense that, on average, productivity draws will be higher (formally, this entails first-order stochastic dominance). Apart from T, countries also differ in size, L. Assuming away trading costs for simplicity, wages are determined by the ratio of technology to size, T/L. A high T/L means that the country would have many sectors in which it has absolute advantage relative to its size, leading to a high equilibrium wage. Moreover, given L, a higher T implies the production (and export) of more goods, or more diversification.

Of course, higher productivity and higher wages may not go together with diversification. For example, high productivity in a sector that is not "diversified" or "differentiated" would draw resources away from the diversified sector and reduce overall diversification even as it increases overall produc-

tivity and wages. It is also important to recall that the data reveals that after a certain level of development, higher income goes together with less, not more diversification (see Imbs and Wacziarg, 2003).

An interesting way to think about diversification is via what Hausmann and Rodrik (2003) call "self-discovery." They argue that countries don't really know their cost structure, and hence they don't know the goods in which they have comparative advantage. This must be discovered through costly experimentation, which is plagued by information spillovers that render its private benefits low relative to its social benefits. The following model shows a simple way to capture the connection between diversification and productivity, and then between self-discovery and diversification.

Consider an economy with labor as the only factor of production and two sectors: agriculture and manufactures. Agriculture is a homogenous good, produced with decreasing marginal returns to labor, with $Q_A = \lambda F(L_A)$. There are a continuum of manufacturing goods indexed with $j \in [0,1]$ that are produced from an input $H = \varepsilon L$ (ε converts raw labor units L into efficiency units H) with productivities as in Eaton and Kortum (2002): one unit of H produces z units of manufactures, with z for each good $j \in [0,1]$ drawn from the Fréchet distribution with parameters T and ϕ, as above. Assuming no transportation costs for either agriculture or manufacturing, and letting agriculture serve as numeraire, then the wage is $w = \lambda F'(L_A)$. The cost of producing a manufacturing good with productivity draw z is $w/\varepsilon z$, and, analogous to the expression in (9), the share of manufactures that will be exported by a country with wage w, labor efficiency ε, and technology parameter T, is

$$\frac{(w/\varepsilon)^{-\phi} T}{\sum (w_l/\varepsilon_l)^{-\phi} T_l}$$

Consider now two countries that differ only in λ, ε or T. The country with higher λ will exhibit a higher wage, but will also devote more resources to agriculture and less to manufacturing, with a smaller share of manufacturing goods exported and a lower level of diversification (i.e., the number of goods exported is lower). This is a case of "good concentration." On the other hand, a country with a lower ε or a lower T would also have a higher share of labor in agriculture, with higher concentration, but in this case the equilibrium wage would be lower. This is a case of "bad concentration."

Now let us think about the determinants of T. In a dynamic setting, T can be seen as the stock of ideas (see Eaton and Kortum, 2001). Imagine

that there is a worldwide stock of ideas, T^*, that grows at rate n. Discovery can be seen as the process by which a country adopts these worldwide ideas to the national environment. This is not exactly as in Hausmann and Rodrik (2003), where productivity is determined ex-ante, and experimentation simply reveals what that productivity is. But the basic implications are the same. If x is the rate of discovery, then $\dot{T} = xT^*$, and in steady state $T/T^* = x/n$. Thus, a higher rate of discovery leads to diversification and a higher equilibrium wage.[25]

The rate of discovery depends on its cost and associated private returns. If there are knowledge spillovers, as in Hausmann and Rodrik (2003), so that once an entrepreneur adopts a foreign idea then it diffuses rapidly to others in the economy, then the market by itself would lead to a suboptimal level of discovery and a level of diversification that would be too low. Polices to encourage discovery would lead to more diversification and higher welfare.

2.5 National and Global Gains from IP

The gains from IP for a country could come at the expense of other countries, or they could lead to global efficiency gains. We now explore the nature of the gains from IP for the different models discussed above.

Consider first the case in which the existence of Marshallian externalities leads to multiple equilibria. Above we considered a small country, but to explore whether gains are national or international we have to allow for the possibility that a country's IP hurts other countries. Consider a model with two countries (A and B) and two goods (1 and 2). As above, good 2 exhibits Marshallian externalities. In this context, IP entails a shift from an equilibrium in which countries are *not* specialized according to their comparative advantage to one in which they are. Clearly such a shift increases worldwide efficiency. What happens to welfare in each of the two countries? First note that the country that implements IP (country A) experiences an increase in productivity in industry 2. If the terms of trade didn't change, country A would be better off (as in Subsection 2.1.2). But if A is not small, then the

[25] This is not consistent with what happens for rich countries, where higher productivity goes together with falling diversification. One way to think about this is that at some point a third sector emerges, a high-tech sector, which is a simple CRS sector where research implies increasing productivity. When T and productivity in high-tech is sufficiently high, the agriculture sector disappears, and increasing productivity in high tech leads now to falling exports of manufactures and increasing concentration.

relative price of good 2 will fall, and this will erode some of A's productivity gains. Even if A was so large that the terms of trade were now equal to its domestic prices, however, it would still gain, so country A necessarily gains from IP.[26] This is a simple application of Helpman and Krugman's (1984) proposition that a country necessarily gains from a move to an equilibrium in which it allocates more resources to a sector with positive externalities. For the other country (country B) welfare can decrease. To see this, note that for this country the effect of IP is exactly the same as the effect of an increase in productivity in industry 2 in country A. This could be either positive or negative for country B. For example, if the opportunity cost of good 2 in country A is just barely lower than the opportunity cost of good 2 in country B when both countries fully exploit the Marshallian externalities, then it is clear that country B loses from the IP implemented in country A.

Different results arise when IP is geared towards the appropriation of rents or broad (inter-industry) externalities associated with certain goods, as in the literature on strategic trade policy (see Brander, 1995). In this case, the use of IP by different countries entails essentially a zero-sum game, or worse, as it could lead to an allocation of resources in which countries are not specialized according to comparative advantage.

Consider next the model where IP entails industry-specific collective action. If collective action is costless, then the answer is very simple: IP necessarily increases global welfare, although it may hurt another country by worsening its terms of trade. Things become more interesting when collective action entails costs. If countries bargain efficiently among themselves regarding trade barriers, then (by definition) only IP that increases global welfare will be implemented. One could optimistically argue that global negotiations that include trade and other policies actually take into account the ability of countries to implement IP, and that the resulting agreements allow only policies that increase global welfare. In this case, countries that can follow IP that increases their own welfare but lowers global welfare would be paid (perhaps though better trade access to other countries) not to do it, and countries that can implement IP that lowers national welfare but increases global welfare would be paid to do it. In fact, this is the way that trade agreements work in Bagwell and Staiger's (1998) model of GATT.

Bagwell and Staiger show that as long as countries choose their policies

[26] A key ingredient in generating this result is that country $A's$ opportunity cost of good 2 falls below that of country B, a result of $A's$ latent comparative advantage in good 2.

while disregarding their effects on international prices, then they will lead to a globally efficient outcome. If international agreements are not efficient in this sense, however, then countries would evaluate the impact of IP on welfare while taking into account its effect on international prices. Clearly, this could lead to a decline in global welfare. For example, imagine that countries have committed to free trade. If IP for some good X implies a reduction in the supply of some other good Y then the price of this good would increase. If IP just barely makes the Home country implementing it better off, then for the world as a whole (which necessarily sees a decline in TOT) this entails a loss. Note, however, that this is a general feature of domestic policies implemented by countries that affect international prices, and not something particular to IP.

Finally, we turn to the model where IP aims at promoting diversification. As in the cases discussed above, the problem for global welfare may arise from the influence of IP on international prices. Imagine that the cost of a policy to encourage "self-discovery" just barely justifies the associated benefits. If such benefits include an improvement in a country's terms of trade (which would arise from the decline in the supply of the non-diversified good), then the global efficiency would decline. Again, global efficiency would necessarily increase from IP only if countries evaluate it while disregarding its impact on international prices.

3 Empirical Evidence on Infant-Industry Protection and other forms of IP

Since the best known form of IP is infant-industry protection, we devote most of this section to a critical review of the empirical literature on this type of IP. As discussed in Section 2, the theoretical justification for infant-industry protection relies on the existence of Marshallian externalities. There is extensive evidence that these externalities exist and are significant (Rosenthal and Strange (2004)). When such externalities exist, temporary protection may help the country switch towards a better equilibrium, and this may be welfare improving if the short-run costs are not too high. Protection may also be welfare enhancing if the protected industry generates positive (inter-

industry) externalities to the rest of the economy.[27]

As we outlined in Section 2, such a policy would be welfare enhancing only if it passes both the Mill and Bastable tests. Recall that the Mill test requires that the protected sector can eventually survive international competition without protection, whereas the Bastable test requires that the discounted future benefits compensate the present costs of protection. We emphasize in our review that very few studies of IP have examined whether industries pass either the Mill or the Bastable test. Consequently, even if we could show that protected sectors grow faster, this is not sufficient evidence to claim that IP is justified from a welfare standpoint.

Even if the conditions necessary for protection to increase welfare are satisfied, protection is not the first-best policy. The theory of targeting (see Bhagwati and Ramaswami (1963)) suggests that a government's objectives can be met more efficiently using instruments other than tariffs, and that when these instruments target the distortion at the source, the optimal tariff for a small economy is zero. Unless there are specific distortions or externalities associated with trade, the first-best policy instrument to conduct industrial policy is not likely to be tariffs. In a recent review on the fiscal implications of trade reform, Pelzman and Shoham (2006) point out that "in the theoretical public finance literature it is well established that an optimal policy for a small open economy is to reduce tariffs to zero and raise consumption taxes (see Dixit (1985) and Diamond-Mirrlees (1971)), thus maintaining production efficiency" (p. 9).

In practice, however, there are several reasons why countries have continued to use tariffs to promote domestic industry. The first best policy instruments are frequently not available in countries with limited abilities to collect income, consumption, or production taxes. Anderson (1996) shows that in a budget constrained economy, where it is difficult to compensate tariff cuts with increases in consumption or other taxes, tariff reductions lead to a curtailment of government spending and a resulting under-provision of public goods, which lowers welfare. Irwin (2007) compares the deadweight losses per dollar of revenue raised by tariffs with other forms of taxation in the United States. He argues that although the deadweight losses (per dollar) for tariffs were high in the 19th century, "import duties were probably much easier to collect and enforce... than other modes of taxation" (p. 19). Irwin

[27] It is important to note that this is not infant-industry protection, however, since the protected industry is not presumed to become competitive at some future period.

(2002) draws similar conclusions for Argentina and Canada at that time. For the same reasons, it could be argued that in some developing countries trade protection could be a reasonable policy tool to implement IP. An important implication is that if fiscal considerations are the reason to use trade protection rather than production subsidies, then clearly tariffs would be the right policy and not quantitative restrictions.

In the rest of this section we review the empirical research on the effectiveness of infant-industry protection. We begin by discussing case studies where protection was clearly motivated by infant-industry considerations and then move on to other approaches that exploit the cross-industry and cross-country variation in trade barriers to see whether protection had the consequences predicted by infant-industry models.

3.1 Single-Industry Studies

There are very few detailed evaluations of infant-industry protection. Some important papers that explicitly take into account learning effects include Baldwin and Krugman (1986, 1988), Head (1994), Luzio and Greenstein (1995), Hansen, Jensen, and Madsen (2003), and Irwin (2008). Baldwin and Krugman (1986) study protection to the semi-conductor industry in Japan. They use a simulation model to show that the Japanese semi-conductor industry in Japan could not have emerged as a global player without the protected domestic market. Protection was needed in order to achieve the kinds of economies of scale and learning effects that would allow the industry to move down its marginal cost curve and be competitive on world markets. However, Baldwin and Krugman (1986) also find that the costs to Japanese consumers outweighed the benefits, leading to net welfare losses for both Japan and the US. Thus, although the semi-conductor sector in Japan satisfied the Mill test, it did not satisfy the Bastable test.

Baldwin and Krugman (1988) estimate the impact on US and European welfare of Airbus's entry into the imperfectly competitive aircraft model. They show that subsidies to Airbus may have resulted in net welfare gains for Europe, primarily due to the high degree of imperfect competition (and monopoly rents) that characterized the industry. However, their simulation also makes clear that these results depend heavily on the assumed parameters, including the elasticity of demand. In any case, it is possible to evaluate that sector in such a way that the European subsidy to Airbus passes both the Mill and the Bastable test.

Head (1994) studies the effect of tariff protection on the emergence of the steel rail industry in the United States. This case fits the infant-industry protection view almost perfectly: the local industry was initially uncompetitive (1860s), but a few decades after the imposition of an import tariff the United States was the world leader in this market and the duty was repealed. Head concludes that "the domestic industry did 'grow up' and the duty was eventually removed. Hence, protection certainly did not cause stagnation and gross inefficiencies. Furthermore, the duty led to long-run reductions in domestic prices. While the savings to railroad builders were too small and came too late to yield a net gain to consumers, the overall effect on welfare appears to have been positive" (p. 163).

Hansen, Jensen and Madsen (2003) examine the effect of production subsidies in Denmark for the production of electricity from wind power. They conclude that the subsidies elicited strong learning-by-doing in the industry, which achieved a dominant position in the world market. Moreover, according to their calculations, the direct and indirect (environmental) benefits outweighed the overall costs of the policy.

Irwin (2008) evaluates the effects of protection in the tinplate industry in the United States. The industry flourished after receiving tariff protection in 1890. Whereas there were no US producers at all prior to the imposition of the tariff, after the imposition of the tariff (at rates exceeding 70 percent) the industry became entirely self-sufficient. According to his counterfactual simulations, the tariff accelerated the industry's development by about ten years, which would have developed anyway due to falling costs of iron ore. However, the costs to consumer surplus were so large that welfare declined as a consequence of protection. Irwin concludes that a lower tariff of around 50 percent could have been justified by net welfare calculations, but that the actual tariff imposed was too high.

All the previous studies are for cases of protection or subsidies in developed countries. One single-industry study of infant-industry protection in a developing country is that of Luzio and Greenstein (1995), who study the effects of protection of the microcomputer industry in the 1980s in Brazil. They show that although there was rapid productivity growth in the protected industry, it never caught up with the also rapidly growing technological frontier. As a result, welfare declined by a significant amount (around 20 per cent of domestic spending on microcomputers) and the policy was abandoned in the early 1990s.

More studies like these analyzing the welfare implications of infant in-

dustry protection would be very useful. Yet even this brief review makes it clear that protection may lead to higher growth but result in net welfare losses. For tinplate, steel rail, wind power, semi-conductors and aircraft, protection allowed domestic producers to grow and eventually become world class producers Yet for tinplate, semiconductors, microcomputers, and possibly aircraft, protection led to net welfare losses. These case studies suggest that getting interventions "right" in terms of welfare is very difficult.

3.2 Cross-Industry Studies

The theoretical framework makes a number of predictions for cross-country empirical studies. If the conditions necessary for infant-industry protection to improve welfare are satisfied (see Section 2) are satisfied, then protected sectors should experience faster productivity growth than non-protected sectors. With time, protected sectors should increase their importance in the economy, and eventually become exporters. Under these conditions, one would expect to find a positive correlation between trade protection and productivity growth.

One of the first studies to look for a correlation between trade protection and productivity growth is Krueger and Tuncer (1982). Using cross-industry data on protection and productivity growth for Turkey in the period 1963 - 1976, these authors conclude that the empirical evidence does not provide support for the infant industry argument. However, Harrison (1994) uses their data to show that more protected sectors did in fact exhibit higher productivity growth. As pointed out by Harrison, "Krueger and Tuncer (1982) applied *no* statistical tests to support their conclusion...If one runs simple correlations..one obtains striking results: Krueger and Tuncer's data show a statistically significant *positive* relationship between increased protection and higher productivity growth. In contrast to their stated conclusions, it is possible to show that, in Turkey, protected industries did in fact achieve greater productivity gains during the sample period."

While Krueger and Tuncer's results appear to show some support for infant industry protection, most studies find little support. Cross-industry studies usually show that the removal of protection generates both intra-firm and intra-industry productivity gains (possibly through market share reallocations, just as in Melitz, 2003). This includes work by Pavcnik (2002), Tybout and Westbrook (1995) for Mexico, Harrison (1994) for Cote d'Ivoire, Nishimizu and Page (1982) for Yugoslavia, Kim (2000) for South Korea,

Topalova (2004) for India, Muendler (2003) for Brazil, Beason and Weinstein (1996) for Japan, and others.

Rodrik (2007) has criticized the use of cross-industry studies to test for the success of IP on the grounds that if IP is designed to deal with market failures that impede sector growth, then one should not be surprised to find a negative correlation between protection and growth. He assumes that $g_i = (1 - \theta_i)A$, where g_i is the growth rate of industry i, θ_i is an index of market failures, and A is a parameter that captures productivity growth that is common across industries. In this framework, industries with stronger market failures would exhibit slower productivity growth. If there are political or fiscal costs associated with the promotion of an industry then in equilibrium one would find industries with a higher θ_i exhibiting stronger promotion and lower growth. Rodrik's point is that lower growth could be perfectly consistent with a successful IP, just as it is consistent with a politically motivated policy of promoting sunset sectors. Rodrik's argument may be correct for certain types of IP, but not for IP *associated with the infant industry argument* (as defined in Section 2), since this would generate a *positive* correlation between protection and productivity growth. Even if Rodrik were correct in the short run, we would expect that in the longer term successful examples of infant industry protection would lead eventually lead to growth.

In any case, there is a more fundamental problem with existing tests of infant industry protection. There is no evidence to suggest that intervention for IP reasons in trade even exists. If intervention were motivated by IP reasons, we would expect the pattern of protection to be skewed towards activities where positive externalities or market failures are largest. Instead, existing evidence suggests that protection is motivated by optimal tariff considerations (Broda, Limao, and Weinstein, 2006), for revenue generation, or to protect special interests (Goldberg and Maggi, 1999, Gawande, Krishna and Olarreaga, 2005). Tariff protection is frequently granted to less successful firms or declining industries. Beason and Weinstein (1996) study the pattern of industrial targeting in Japan and specifically ask whether the government targeted industries with increasing returns or emerging sectors such as electrical machinery. They find the opposite result: protection and other forms of targeting such as capital subsidies were highest for declining industries and industries without increasing returns. Most tariff protection was heavily concentrated in processed food and textiles, while most subsidized loans and tax relief went into mining. Beason and Weinstein conclude that "industrial policy considerations were dominated by the desire to aid declin-

ing sectors or protect the interests of large unproductive industries". Lee (1996) reaches similar conclusions for South Korea.

Harrison and Hanson (1999) find that in Mexico in the 1980s the pattern of trade protection was skewed towards food processing and garments, presumably for political economy reasons since these were sectors where Mexico already had a comparative advantage. More recently, Mobarak and Purbasari (2006) use a database on firms granted import licenses for raw materials and commodities in Indonesia to show that politically connected firms are more likely to be granted protection. However, firms that export are significantly less likely to be granted support. This suggests that firms most likely to succeed on world markets in Indonesia were in fact penalized by restricting their access to import licenses.

There are a number of other areas where additional research is needed. To properly test the type of model presented in Section 2, we would expect initial output and productivity gains from the imposition of tariffs; later removal of these tariffs would generate no effects. We are not aware of any studies that test for these asymmetric effects of imposing protection and later removing tariffs through trade reform. Nor do existing empirical studies address the many other reasons why infant industry protection may not work. Domestic demand in LDCs may lack the level of sophistication that would induce firms to meet the quality standards necessary for penetrating richer markets (Porter, 1990). Porter also argues that weak competition in small protected markets may not provide the incentives that firms need to upgrade their technologies and increase their efficiency. Small markets may also fail to reach a critical mass where Marshallian externalities are fully exploited. Moreover, as mentioned above, industries that use simple production methods may expand without the generation of any externalities, even if those same industries do exhibit strong Marshallian externalities in rich countries (Baldwin, 1969, Rodríguez-Clare, 2007). Firms may believe that protection will fail to create a cluster, and so they may decide not adopt the production methods that lead to externalities but are profitable only within a cluster. In other cases protection may actually favor the use of backward technologies that do not contribute to the generation of higher industry-level productivity (Sauré, 2007).

The realization of Marshallian externalities is a much more complex process than what the model in Section 2 suggests. As argued by Rosenthal and Strange (2005), "there are many different aspects of a location that may matter to firms. A well-intentioned policy could easily fail because it failed

to attend to one or two of these... it may not be possible to duplicate elsewhere the circumstances that led to a successful agglomeration in another place... This is not to say that government policy has never contributed to the formation of clusters. It certainly has, but the formation of clusters has been a side-effect rather than the primary goal of the policy..." (p. 19). In other words, the econometric evidence regarding Marshallian externalities may in fact be telling us that agglomeration may be *necessary but not sufficient* for increased productivity. If a certain factor, policy or institution is necessary for geographic concentration of an industry to lead to higher productivity, then we may observe Marshallian externalities taking place in advanced countries, but not in LDCs. To put it crudely, subsidizing the software sector may not generate a Silicon Valley in a developing country.

3.3 Cross-Country Studies

There are a number of cross-country studies evaluating the success of IP. These can be grouped into (1) testing for an association between protection and country performance and (2) qualitative case study evidence. A number of recent studies emphasize the importance of the *pattern of protection* in understanding possible linkages between IP and economic growth. These include O'Rourke (2000), Clemens and Williams (2001), Chang (2002), Irwin (2002), Lehmann and O'Rourke (2008),

O'Rourke (2000) and Clemens and Williamson (2001) both find a positive correlation between import tariffs and economic growth across countries during the late nineteenth century These two studies hypothesize that protection was associated with growth because it allowed countries to accelerate the growth of what were then "emerging" sectors (industry) out of "declining sectors" (agriculture). These emerging sectors were characterized by learning effects and the kinds of Marshallian externalities modelled in Section 2. These new explanations for the observed positive relationship between growth and protection at the turn of the twentieth century could also be used to explain how first Britain, and then the United States, were able to emerge as economic leaders in conjunction with tariffs that were very high in the eighteenth and nineteenth centuries. Chang (2002) claimed that protection was essential in the transformation of the United States into an industrialized economy in the 19th century. Others (for one such view, see Sir Arthur Lewis, 1955) have argued that Latin America's relatively high growth rates during the 1960's and early 1970's in a time of high effective rates of protec-

tion was also no coincidence.

Irwin (2002) casts doubt on the meaning and robustness of such correlations, arguing that rather than a causal relationship from protection for IP reasons to growth, the positive correlation comes from the fact that a few fast growing countries (e.g. the United States, Canada, Argentina) imposed high tariffs as a means of raising fiscal revenues. Lehmann and O'Rourke (2008) are able to address this criticism by purging their results of tariffs imposed for revenue purposes.

As pointed out by Lehmann and O'Rourke (2008), *what* you protect matters. If the pattern of protection is skewed towards increasing returns sectors where there are important externalities, then IP would be much more likely to work than if protection is given to declining sectors or sectors without externalities. In their book analyzing whether openness to trade is likely to be associated with higher growth, Grossman and Helpman (1991) make a similar point. Lehmann and O'Rourke examine the pattern of protection and growth for a sample of developed countries during the period between 1875 and 1913. They find that while agricultural tariffs were negatively correlated with growth, industrial tariffs were positively correlated with growth. Lehmann and O'Rourke also separately examine the relationship between growth and what they refer to as "revenue tariffs"–tariffs imposed on goods not produced at home and applied to raise revenue. They find no relationship between tariffs imposed to raise revenue and economic growth. They do not, however, estimate the impact of protection on productivity growth, nor do they calculate the net welfare effects of these policies.

Two other recent studies that emphasize that it is the pattern of protection which matters and not the average level of protection include Nunn and Trefler (2004) and Estevadeordal and Taylor (2008). Nunn and Trefler (2004) find that countries which protect skill-intensive sectors grow more rapidly than countries which protect unskilled-labor-intensive industries. Estevadeordal and Taylor disaggregate tariffs into consumption, capital goods, and intermediate goods tariffs. For the 1970s through the current decade, Estevadeordal and Taylor show that tariff protection affects growth negatively only if tariffs are on capital or intermediate goods. There is no association between tariffs on consumption goods and long run growth. We continue and expand this discussion to include a more general evaluation of the literature on trade and growth in Section 4.

Another approach relies on qualitative case study evidence to contrast the apparent success of East Asia countries relative to Latin America and

elsewhere in the use of industrial policy. There is significant debate over whether the use of a range of industrial policy instruments, including infant-industry protection, helped or hurt development in East Asia. A common view is that East Asian countries used export subsidies whereas Latin American countries used import tariffs, and that this explains part of the difference in performance in these two regions. In fact, East Asian countries used both import tariffs and export subsidies, and this created a setting in which the incentives were neutral regarding import substitution versus exports, although manufacturing as a whole enjoyed some net promotion (World Bank, 1993). China's policies over the last twenty five years could similarly be described as using both import tariffs and export subsidies.

South Korea and Taiwan had tremendous rates of physical and human capital accumulation over the 60s, 70s and 80s, and this went together with rapidly changing comparative advantage towards capital intensive goods. Of course, the standard explanation of this experience is that capital accumulation caused by some exogenous factors led to a changing comparative advantage. But an alternative interpretation, consistent with the model presented in Section 2.1.2, is that such a structural transformation was not inevitable because of multiple equilibria. In particular, without protection or promotion of the capital intensive sectors, countries would have remained specialized in the sectors where they enjoyed a static comparative advantage; since these sectors were not capital intensive, then capital accumulation would not have taken place. Amsden (1989) and Wade (1990) have argued that IP was crucial for some East Asian countries to capitalize on their latent comparative advantage in advanced manufacturing.

It is clear that East Asian countries indeed pursued several policies to encourage particular sectors, such as production subsidies, subsidized credit, fiscal incentives, and trade protection. But what was the actual effect of these policies relative to what would have happened in their absence? Can IP be credited with bringing about the successful industrialization experienced in East Asia? One approach in the literature has been to check whether the industries that received most support are the ones that have grown most rapidly.[28] As we discussed above, protection is typically motivated by political or terms of trade reasons rather than prospects for higher growth through IP. In the late twentieth century, in contrast to the last century when indus-

[28] Beason and Weinstein (1996) perform this exercise for Japan while Lee (1996) does it for Korea. See Noland and Pack (2003) for a comprehensive review of this literature.

trial countries protected emerging industries, it appears that trade barriers are often designed to protect "sunset" industries rather than to encourage "sunrise" industries (see Noland and Pack, 2003).

3.4 Export subsidies and other forms of IP

We have organized our discussion of the empirical evidence regarding the effectiveness of IP on infant-industry protection. But clearly there are many other forms of IP: countries could subsidize exports across the board or in particular industries, they could impose differential taxes, as well as differentiated production, credit and R&D subsidies. Since a comprehensive review of all forms of IP is not possible, in the rest of this section we focus our discussion on export subsidies.

Consider again the case in which some sectors exhibit Marshallian externalities. An overall export subsidy would simply preserve the allocation associated with the current pattern of comparative advantage. If export subsidies are targeted to the sectors that exhibit Marshallian externalities, then they could also be effective in switching the economy to the superior equilibrium. Again, production subsidies are less distortionary than export subsidies but they impose stronger fiscal demands. Thus, for governments with great fiscal needs or where taxation is very distortionary at the margin, export subsidies could be a reasonable option, although import tariffs would be superior from a fiscal perspective.

In any case, the argument for the superiority of export subsidies over import tariffs is threefold: (1) that by promoting exports, a country makes sure that firms are subject to the "discipline of the international market," which forces firms to become more productive; (2) that by subsidizing only exporting firms, a country effectively limits the subsidy to firms with high productivity; and (3) that domestic markets may be too small to allow the protected industry to reap the full benefits of Marshallian externalities. All of these arguments are relevant but require some qualification. First, the discipline of the international market applies both to firms that export and to those that sell in domestic markets as long as there are no quantitative restrictions. Second, there is in principle no reason to subsidize highly productive firms over low productivity firms (see Demidova and Rodríguez-Clare, 2007), unless there are barriers that prevent resources from flowing from the latter to the former, in which case the first-best policy would be to remove those barriers. Finally, if the economy is small in relation to the industry

size needed to fully exploit the Marshallian externalities, this is not going to be fixed by an export subsidy. A different and more reasonable argument is that domestic demand is not sufficiently sophisticated, hence firms selling to domestic consumers will not develop the necessary level of sophistication needed for success in international markets. Export orientation for infant industries would avoid this problem.[29]

One could redefine the case for industrial policy as trying to change incentives to produce (or export) some goods and not others. What evidence is there that what a country exports (or imports) matters? There are a number of studies listed in Table 2 which suggest that the growth effects of openness hinge on the composition of trade. These include Dodaro (1991), Giles, Giles and McCann (1992), Hansen (1994), Ghatak, Milner, and Utkulu (1997), Pineres and Ferrantino (1997), Xu and Wang (1999), Choudhri and Hakura (2000), Khalafalla and Webb (2001), and An and Iyigun (2004). With one exception, all these studies find that exports are more likely to lead to growth if they are in non-traditional sectors such as manufacturing or skill-intensive goods rather than primary products or raw materials; studies also find that greater export diversification is more likely to be associated with growth.

Hausmann, Hwang and Rodrik (2005) develop a measure of the sophistication of a country's exports based on the level of GDP per capita associated with the export of different goods worldwide. Once they have attached a level of GDP per capita to each detailed export category based on which countries export the good, they can then derive the implied GDP level of a country's exports. Countries whose export baskets contain items typically produced by higher income countries have a "high" level of export sophistication relative to what would be expected given their level of development. In principle, one could construct a measure of the distance between the implied income level of a country's exports and the country's actual level of GDP per capita. In a related paper, Rodrik (2006) shows that China's exports in 1992 were associated with an income level more than six times higher than China's per-capita GDP at that time. Rodrik suggests that the gap between the implied level of income of China's exports and China's actual GDP per

[29] Although we have focused on trade policies, the use of local-content requirements on foreign producers can also be justified by appealing to Marshallian externalities. In fact, such requirements force multinationals to buy local inputs just as protection induces domestic consumers (and firms) to buy from local producers. A major difference, of course, is that local-content requirements are quantitative restrictions rather than explicit tariffs or subsidies.

capita is too large to have occurred naturally and is one outcome of China's activist industrial policy.

These studies suggesting that what a country exports is more important than how much the country exports for long run growth are suggestive that IP has played an important role in country growth experiences, but are not conclusive. No researchers have identified an association between the existence of Marshallian externalities in particular sectors, industrial promotion of those sectors, consequent changes in the commodity composition of a country's export basket, and growth. Consequently, we can only loosely infer that rapid changes in the composition of a country's exports towards more sophisticated products could be indicative of IP.

4 Trade and Economic Development

Countries intervene in trade for many reasons, including the desire to shift production towards sectors with positive externalities (industrial policy), to raise revenue, to affect terms of trade, and to satisfy special interests. We reviewed in Section 3 some of the studies that explicitly evaluate the success of IP. There is almost no research that has been able to isolate the effects of IP on welfare, taking into account all the other motives for protection. However, there is a large literature which estimates the reduced reform relationship between openness to trade and economic growth. In this section, we review nearly 200 prominent studies that use some kind of reduced form approach. We identify the different measures of openness used in this literature, the datasets, the identification strategies, and the results

Can we use this vast literature to cast light on the IP debate? In defining openness to trade, we make a distinction between trade volumes, such as exports or imports, and trade policy, such as tariff reductions or changes in quotas. Most of the studies we review below find a positive relationship between trade volumes and growth. While there are far fewer studies that evaluate the linkages between tariffs and growth, they tend to get insignificant or weak effects. This should not be surprising given the mixed motives for imposing tariff protection. We hypothesize that these different results imply that industrial policy is more likely to be successful if it is "pro-trade". Yet from a practical standpoint, it is difficult to envision a successful set of policies that are both pro-trade and protectionist; at a minimum, this

would require policies that fully offset any anti-trade biases. The positive correlation between trade shares and growth is consistent with our hypothesis that IP implemented via export promotion and encouragement of FDI has generally been more successful than protection to trade. Before we turn to the literature on trade volumes, trade policies, and country outcomes, we begin with some stylized facts.

4.1 Stylized Facts on Trade policies, 1980-2004

If we use a conventional measure of trade volumes such as export shares in GDP, developing countries are now more integrated into the world economy than the industrial countries. Figure 2 shows that export shares for developing countries overtook industrial countries in the early 1990s.

Figure 2: Export Shares in Developing and High-Income Countries

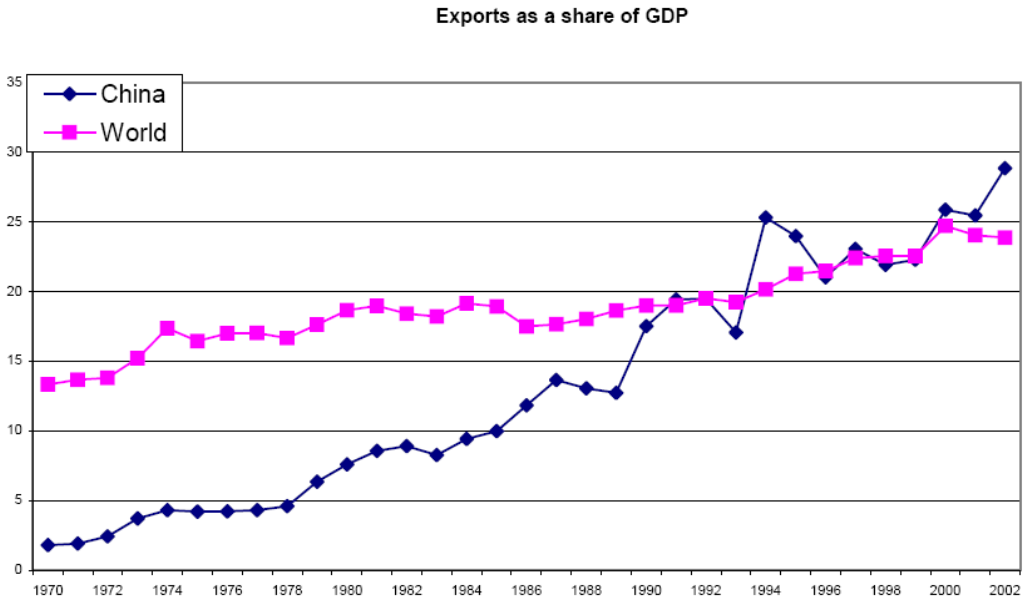
Table 1 shows the evolution of country trade policies over the last twenty five years. Countries are ranked according to the net change in tariff levels between 1985 and 2004. We have included both developing and developed countries to provide an indication of how protection changes at different

stages of development. The first four columns indicate the ratio of tariff revenues to trade flows, taken from the World Bank. The next four columns report the actual administrative tariffs, averaged across import categories between 1980 and 2004. The last three columns report changes in these tariffs between 1985 and 2004. The last column indicates the change in the standard deviation of tariffs over time; this measure is an indication of the change in the dispersion of tariffs.

It is evident from Table 1 that there has been a dramatic decline in tariff protection among developing countries. Average tariffs in India declined from 98.8 percent in 1980 to 28.1 percent in 2004; in Bangladesh from 102.2 in 1985 to 16.4 percent; in Costa Rica from 55 percent to 5.7 percent; in China from 49.5 percent in 1980 to 9.8 percent in 2004; in Turkey from 44 to 2.6 percent, and in Chile from 30 to 4.9 percent. Not all countries had such enormous declines, however: in Algeria, average tariffs only declined slightly, from 21 to 18 percent.

There are several other features worth noting in Table 1. The last column of Table 1 shows that there has been a dramatic decline in tariff dispersion, as indicated by the fall in the standard deviation of tariffs. There is also a large discrepancy between tariff revenues as a percentage of trade flows ("revenue tariffs") and actual statutory tariffs. Revenue tariffs are reported in the first 5 columns of Table 1, while statutory tariffs are reported in columns 6 through 10. To illustrate the difference, Table 1 shows that average tariffs in India in 1980 were 98.8 percent but tariff collections as a percentage of trade were only 15.5 percent. In Paraguay, average tariffs were 71 percent in 1980, while tariff collections were 6 percent; in Costa Rica, tariffs were 55 percent and collections were 5.3 percent; in Chile, average tariffs in 1980 were 30 percent but tariff collections were 2.8 percent. The difference between these two measures reflects in part the role of tariff exemptions–typically state enterprises were exempt from paying tariffs, as were many exporters and foreign enterprises—as well as selective imposition of duties by customs officers and the negative impact of high tariffs on imports.

We also highlight the historically high levels of protection in China. China has arguably had the most spectacular success in integrating into the world economy in the last two decades. Yet in 1990, it was still one of the most protected economies in the world, with an average tariff rate of 40 percent. According to Table 1, in 1990 China was tied for fifth place in average levels of tariff protection, behind Bangladesh, India, Pakistan, and Kenya. The dispersion of tariff levels was also high, and the maximum tariff exceeded



Source: World Development Indicators Database

Figure 3: Exports as a share of GDP

200 percent. Figure 3, taken from Rodrik (2006) documents that much of China's export surge occurred simultaneously with the imposition of high tariffs. Nevertheless, countries such as China and India—because they had such high tariffs to begin with—also exhibited the highest tariff reductions between 1985 and 2004.

4.2 Cross-country Evidence on Trade Policies, Trade Volumes, Productivity, and Growth

A standard approach in the cross-country literature is to regress an outcome of interest for country i at time t (GDP growth, real GDP per worker, or total factor productivity growth) on a preferred measure of openness and a set of controls Z,

$$Y_{it} = \text{Constant} + \beta OPENNESS_{it} + \phi Z_{it} + \alpha_i + \tau_t + \varepsilon_{it} \qquad (10)$$

Most controversies have arisen over the following three issues:

1. How to measure $OPENNESS$

2. How to account for the endogeneity between Y and $OPENNESS$.

3. Which variables to include in the set of controls Z.

(1) *How to measure openness.* There is a large debate over how to measure openness. The ideal measures for understanding the linkages between trade *policies* and outcomes are measures of policies themselves—such as tariffs and quotas, but until recently, these measures were hardly ever used (see Harrison (1996) for a discussion). How much of a problem is the lack of information on statutory tariffs (in contrast to revenue tariffs) in practice? If the difference between actual tariffs and revenues are due to exemptions in the tariff schedule, then the tariff schedule is misleading, and it would actually be better to use revenues as a share of import value. But if the differential between revenue tariffs and statutory tariffs highlighted in Table 1 reflects the restrictive impact of high barriers on trade volumes, barriers, or corrupt practices which impose rent-seeking costs not reflected in revenues, then using trade revenues to proxy for tariffs is not ideal.

A more fundamental problem which has plagued the literature on the relationship between trade policies and growth is the continued use of trade volumes as a proxy for policy. Trade volumes are affected by many different factors, including policies, distance to neighbors and trading partners, country size, exchange rate movements, terms of trade changes, and barriers to entry. Consequently, simply using trade volumes to proxy for changes in trade policies may be misleading. We evaluate the relationship between these different openness measures in Table 3. We present correlations between actual tariffs, trade taxes as a percentage of trade, two measures of trade volumes, the nominal exchange rate, and the ratio of foreign investment inflows to GDP using annual data from 1980 through 2004. For trade shares, we include both nominal and real trade shares, where real trade shares are defined as the ratio of trade to GDP in constant prices from the Penn World Tables (version 6.1). Table 4 repeats the same exercise, but restricts the sample to developing countries. The correlations reported in Tables 3 and 4 highlight the following:

- Although Table 1 indicates a big difference in magnitude between the ratio of tariff revenues to trade and actual administrative tariffs, the

correlation coefficient reported in Table 3 between the two measures is actually quite high at .63 and statistically significant.

- There is a significant negative correlation between trade shares and tariffs. The correlation with nominal openness is -.25. The correlation with real openness about the same, between -.2 and -.3, depending on which measure of tariffs is used.

- The negative correlation coefficient between trade policies (tariffs) and outcomes (trade shares) does not depend on how tariffs or trade shares are measured.

- Tariff levels are highly (negatively) correlated with the ratio of foreign investment inflows to GDP, and trade volumes are highly (positively) correlated with foreign investment inflows. In fact, trade flows are more highly correlated with foreign investment inflows than they are with tariffs. These correlations suggest that measures of openness may also be capturing the gains from foreign investment inflows.

- The correlations are the same or stronger if we restrict the sample to developing countries (see Table 4). Trade taxes as a share of trade flows continue to be highly correlated with actual tariffs. The correlation coefficient between trade shares and both tariff measures increases to (negative) .36.

These stylized facts suggest that trade taxes as a share of trade are a much better proxy for average tariffs than trade shares. The correlation coefficient of statutory tariffs with revenue tariffs is significantly higher than the correlation of statutory tariffs with trade shares (.70 versus -.35). Yet researchers continue to rely on trade shares as a measure of trade policy, despite the easily available (World Bank or IMF) tariff revenue measure. The other broad conclusion we can draw from these data is that there is a significant positive relationship between less restrictive trade policies and higher trade shares. Pritchett (1996) suggested that:

> "alternative objective measures of trade policy are completely uncorrelated across countries. This result has serious implications for empirical research that attempts to assess the effects of liberalization on economic performance using comparisons across

countries; it also highlights the difficulties of interpretation in these types of empirical studies".

We would argue that this is not the case: statutory tariffs are highly correlated with revenue tariffs, indicating that they are excellent measures of trade policy There is also a significant and negative correlation between tariff measures and outcome measures such as real or nominal trade shares in GDP. Nevertheless, the magnitude of the (inverse) correlation between trade shares and trade policies is not nearly large enough to allow proponents of free trade to argue that high trade shares always reflect a free trade stance.

Most studies listed in Table 2 use trade volumes as a measure of openness, but trade volumes are outcomes of trade policies as well as a host of factors including geography, shifts in terms of trade, exchange rate shocks, and changes in transport and communication costs. Much of the criticism in the important and widely cited Rodriguez and Rodrik (1999) NBER Macro Annual paper is directed at the inadequacy of typical proxies for openness. Rodriguez and Rodrik find fault with Dollar (1992), Edwards (1998), and Sachs and Warner (1995) for using exchange rate distortions as measures of trade policy, since exchange distortions reflect macro-economic distortions, not trade policies per se. They also critique Edwards (1998) for using a World Bank classification of trade regimes which is subjective. While Dollar's (1992) openness measure seems ideal because it directly measures the deviation of domestic from international prices, Rodriguez and Rodrik argue the measure is primarily correlated with swings in the exchange rate. Dollar (1992) uses the following definition of openness:

$$OPENNESS_i = 100 \left(\frac{P_i}{E_i P_{USA}} \right)$$

$OPENNESS$ is the relative price level compared to the United States, with all price levels converted to US dollars, using Summers-Heston country-specific consumption price indices. A higher price level should indicate a higher degree of distortions. Rodriguez and Rodrik (1999) argue that the law of one price does not hold in general, and that domestic prices could be high for reasons other than trade policy. These could include high transport costs or monopolies in distribution channels. In practice, Rodriguez and Rodrik show that there is no relationship between the openness measure calculated by Dollar and actual tariffs or non-tariff barriers. In fact, tariffs

and non-tariff barriers enter with the wrong sign if this measure of openness is regressed on tariffs and non-tariff barriers. They then show that this measure is primarily capturing exchange rate movements.

Both Rodriguez and Rodrik (1999) and Harrison and Hanson (1999) critique a heavily used measure of openness created by Sachs and Warner (1995). The Sachs and Warner measure has been updated by Wacziarg and Welch (2007), but the updated measure may suffer from the same shortcomings as the Sachs and Warner measure. Harrison and Hanson show that the Sachs and Warner (1995) measure of $OPENNESS$ does not pick up differences in trade policy but instead reflects differences across countries in exchange rate policies and political regimes. One way to reinterpret the evidence presented in Dollar (1992) and Sachs and Warner (1995) is that real exchange rate overvaluation is bad for growth, a theme recently emphasized by Rodrik (2007). One obvious implication for researchers is that any study which measures the impact of real price distortions on growth due to protection should also control for exchange rate movements.

(2) *Endogeneity problems.* Endogeneity problems could arise for many reasons. Policy makers may prefer not to open up to trade until firms are capable of competing on world markets, suggesting that the causality runs from incomes to openness. Even statutory measures of trade policy (tariffs, quotas) are endogenously determined. The pattern of protection is likely to be skewed towards protecting weak sectors,promising infant industries, special interests or vocal minorities.

While empirical work in the 1970s and 1980s largely ignored endogeneity problems, newer studies give much greater weight to constructing plausible identification strategies. This progress is evident in Table 2, which lists prominent studies on the linkages between openness and growth from the 1980s onwards. Most of the early studies had no identification strategy at all, as indicated in column (4). More recent work addresses this omission, using one of two general approaches.

The first approach is to use granger-causality tests that exploit lags in studies that use time-series datasets. As indicated in Table 2, these studies often find that causality runs in the reverse direction, from Y to $OPENNESS$: more successful economies (or sectors) are more likely to open up to global competition. Related to this approach is the use of lags as instruments, which depends on some strong assumptions about the lack of correlation between the instruments and the error term.

The second general approach to identification has been to seek additional instruments for $OPENNESS$. One path-breaking study along these lines is Frankel and Romer (1999). Frankel and Romer use the insights from gravity models to derive an instrument based on geographic proximity. Gravity models predict that countries closer to each other trade more with each other. This means that distance can be used as an instrument for bilateral trade. In the first stage regressions, Frankel and Romer regress the log of country i's trade with country j as a share of country i's GDP on distance and other variables:

$$\ln\left(\tau_{ij}/GDP_i\right) = a'X_{ij} + \zeta_{ij}$$

The vector X includes the log of distance between country i and j, the log of population and area in both countries, and dummy variables indicating whether the two countries share a common border and whether they are landlocked. There are no subscripts for time in this specification: this is a pure cross-section using data for 1985. Frankel and Romer show that greater distance from a trading partner reduces bilateral trade, and they are able to explain 36 percent of bilateral trade in the first stage. Using the first stage estimates, Frankel and Romer then generate an $OPENNESS$ variable by aggregating predicted bilateral trade with all of country i's trading partners. In the second stage, Frankel and Romer regress log of income per capita in 1985 on the predicted trade share, log of population and log of area. They show that $OPENNESS$ positively affects income per capita.

The beauty of this approach is that geographic proximity is without question exogenous with respect to income. There are several problems, however. Since distance does not change over time, the authors cannot allow for country-specific fixed effects α_i in equation (1) and are restricted to pure cross-section estimation. While one solution in principle would be to control for factors that vary across countries but remain fixed over time—such as cultural or institutional differences—it may be difficult to control for all these omitted determinants of income. Another concern is that Frankel and Romer's original results are not very robust: the statistical significance on predicted openness disappears once we add continent dummies, which is not surprising since all the identification is from the cross-section. Frankel and Romer also omit observations with zero bilateral trade in the first stage, which probably contributes to the poor first stage R-square and the resulting weak instrument problem. Rodriguez and Rodrik (1999) are also critical of Frankel and Romer because they argue that greater openness to trade gen-

erated through geographic proximity may have different effects from trade generated through trade policy interventions. One further concern is that the instrumental variable estimates magnify the impact of trade on incomes, in contrast to what one would expect if trade is a positive function of income. The explanation given by Frankel and Romer is that the bias goes in the opposite direction because of measurement error, but one is still left wondering whether or not the authors have successfully addressed the endogeneity of trade to income.

Alcala and Ciccone (2004) use the insights of Frankel and Romer to improve on their initial specification. They use all bilateral trade data available in the first stage, including those bilateral trade pairs with zero trade, which improves the first stage F-statistic from 3.06 using Frankel and Romer's bilateral trade pairs to 11.66. This gives them two and a half times the number of observations in the first stage relative to Frankel and Romer. Consequently, the second stage relationship between their chosen measure of openness and their dependent variable Y (the log of PPP GDP per capita in 1985) is more robust. They also add a measure of institutional quality to the Z vector, which addresses the concern that trade is positively correlated with income or growth because greater openness is correlated with better institutions. They instrument institutional quality with language and settler mortality data, drawn from Hall and Jones and Acemoglu, Johnson and Robinson. Nevertheless, any analysis which uses geography as an instrument is still restricted to a pure cross-section analysis, which requires the researcher to find all possible covariates which could induce a spurious correlation between $OPENNESS$ and Y.

There are other aspects to Alcala and Ciccone (2004) which suggest that the relationship between openness and income in a pure cross-section is not very robust. Trade openness is only significantly correlated with Y if the authors use a "real" measure of openness, defined as the ratio of PPP trade to GDP. Nominal trade shares are not significantly associated with GDP per capita, which leads Rodrik, Subramanian, and Trebbi (2004) to suggest that Alcala and Ciccone's results are driven by movements in the price level, not by trade. It is difficult to be sure, however, since Rodrik, Subramanian and Trebbi do not use exactly the same specification as Alcala and Ciccone.

Romalis (2007) suggests another clever instrument for a country's $OPENNESS$: tariffs imposed by a country's trading partners. In particular, Romalis uses US most-favored nation (MFN) tariffs as an instrument for developing country trade shares. Using this instrument, he shows that the change in real

per capita GDP is positively and significantly affected by trade, and that the magnitude is economically important. Using MFN tariffs is particularly clever, since these are unlikely to be influenced by developing country behavior and are consequently exogenous. This is at the same time a limitation of the approach: the instrument only varies over time, not across countries since the US must apply the same MFN tariffs to all its trading partners. The results also could be interpreted to suggest that other country policies matter for developing country growth, but sheds less light on whether own developing country policies to lower their trade barriers is beneficial for growth. What Romalis shows is that access for developing country exports is beneficial for growth, but his research does not indicate whether opening up import-competing sectors to competition through reductions in protection are also beneficial for growth.

(3) *Which variables to include in the set of controls Z.* The third major area of controversy in this literature is which variables to include in the set of controls Z. There is a growing literature which claims that two key omitted variables from the Z vector, leading to omitted variable bias in early studies, are institutions and geography. Indeed a recent literature has sought to distinguish between institutions, economic geography, and trade as sources of economic growth, including Easterly and Levine (2003), Rodrik, Subramanian, and Trebbi (2004), and Alcala and Ciccone (2004). Only Alacala and Ciccone find that openness matters; the other two studies find that "institutions rule". There are several reasons for why Alcala and Ciccone get very different results from Rodrik et. al. (2004). First, Alcala and Ciccone use real trade shares while Rodrik et. al. use nominal trade shares as their measure of openness. Second, Alcala and Ciccone improve upon the Frankel and Romer measure by expanding the first-stage and using more countries, improving the first-stage F and reducing the fragility of the instrument.

None of these three studies, which have been extensively cited in the empirical literature on the determinants of growth, uses trade policy as a measure of openness. Easterly and Levine (2003) use the Sachs and Warner (1995) and Dollar (1992) measures to proxy for openness; the flaws of these two measures are discussed above. Rodrik et. al. use the average of nominal trade shares for 1950 through 1998 as their openness measure. All three papers focus on a pure cross-section of countries. As pointed out by Harrison (1996), trade policies and trade shares have changed too much over the last forty years to make long run averages very meaningful.

Given the problems inherent in the openness measures, and the reliance on

pure cross-sectional estimation, it is not surprising that openness is trumped by institutions in two of these three studies. This research also highlights the tremendous problems associated with measuring institutions in a way which is distinct from trade policy. The correlation between the openness and institutions measures in Easterly and Levine (2003) is .68, which suggests that multicollinearity is likely to be a significant problem. Both Rodrik et. al. and Alcala and Ciccone use the Kaufmann, Kraay and Zoido-Lobaton measure of institutions, which is constructed from World Bank surveys based on responses for 1997-1998. Yet the dependent variables in these two studies are PPP GDP per capita prior to that period: 1985 PPP GDP per worker for Alcala and Ciccone and PPP GDP per capita in 1995 for Rodrik et. al. It seems odd to try to understand growth in 1985 or 1995 using measures of institutions based on data from the end of the 1990s, unless institutions change very little. Yet if institutions are not time-varying, then they may simply be capturing the country fixed effect α_i in equation (1).

While this survey has highlighted some of the shortcomings of cross-country work on openness and growth, there are several promising new areas of research which deserve mention. Most of the work surveyed so far uses a measure of real GDP per capita or per capita growth as a measure of Y. Yet a number of studies have suggested that openness is important because it allows countries to invest more. Levine and Renelt (1992) show that there is no robust relationship between different measures of openness and average per capita GDP growth in their cross-country sample. Replacing Y with investment shares in GDP, however, they find that openness is robustly correlated with investment rates. They conclude that "the relationship between trade and growth may be based on enhanced resource accumulation and not necessarily on the improved allocation of resources".

Levine and Renelt show that trade matters for growth because it increases investment. One mechanism could be by reducing the price of investment goods. Delong and Summers show that countries with lower investment prices grow faster, and Lee (1995) shows that a higher share of imported capital goods in total investment are associated with higher growth. More recently, Hsieh and Klenow (2007) argue that on the contrary there is no link between lower relative prices of investment goods and trade policy. They cite as evidence the fact that the actual level of prices for investment goods in poor countries are not higher than in the rest of the world. Instead, they argue that investment rates are low in poor countries because the relative price of investment is high relative to non-traded consumption goods, such

as services.

The importance of barriers to investment in understanding linkages between trade and growth is taken up once more by Estevadeordal and Taylor (2008). They estimate a version of equation (1) in differences, but separate their measure of openness into tariffs on consumption goods, intermediates, and capital goods. They also allow for a country fixed effect in differences, leading to a difference-in-difference specification for (1). They show that this approach successfully addresses the problem of whether institutions or trade policy is responsible for higher incomes, since in first differences there is no clear correlation between the two. In addition, they address the potential endogeneity of changes in openness by using as instruments for the change the level of tariffs in 1985 interacted with two measures of what they refer to as "GATT potential": GATT membership in 1975 and a measure of diplomatic pressure constructed from number of diplomats. Estevadeordal and Taylor show that tariff protection only negatively affects growth if tariffs are on capital goods or intermediates, which is consistent with Levine and Renelt's 1992 hypothesis that openness matters because it affects resource accumulation.

A second promising area of research is related to an emerging consensus on the need for openness to trade to be accompanied by key complementary policies. Recent research emphasizing the importance of complementarities between trade and other policies includes Chang, Kaltani, and Loayza (2005), Bolaky and Freund (2006), and Jaffee and Sutherland (2003). One reason why the relationship in (1) may be fragile could be because openness to trade is most successful if implemented in conjunction with other policies–which make it possible for firms to effectively compete on world markets. If such a policy can be characterized as X (there could be overlap between X and Z), then it would lead to a slightly different specification:

$$\begin{aligned} Y_{it} &= \text{Constant} + \beta OPENNESS_{it} + \phi Z_{it} + \delta X_{it} \\ &\quad + \lambda (OPENNESS * X)_{it} + \alpha_i + \tau_t + \varepsilon_{it} \end{aligned}$$

Figure 4, taken from Bolaky and Freund (2006), makes this point graphically. Bolaky and Freund use three different measures of openness, including real and nominal trade shares, and tariffs. In countries with low barriers to entry, there is a positive relationship between openness to trade and growth; in regulated economies, there is a negative relationship. The importance of other policies—in this case, low entry barriers—provides one explanation for

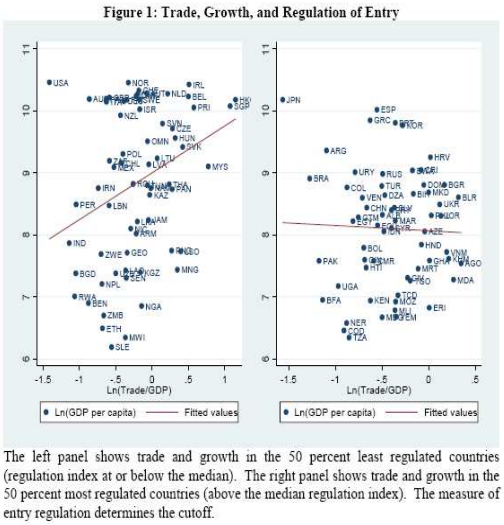


Figure 4: Trade, Growth, and Regulation of Entry.

why it is so difficult to find a robust relationship between openness to trade and good performance. There is simply too much heterogeneity in outcomes, in large part because other types of policies are so different. The necessity for openness to trade to be accompanied by low barriers to entry and exit can be understood in light of new trade theories that emphasize firm heterogeneity, as illustrated by Melitz (2003). In his model, gains from trade occur through reallocation of market share from less productive to more productive firms. If firms cannot easily expand or exit, this important source of productivity gains through trade reforms is lost.

Two other studies also find that gains from trade are contingent on other policies. Chang, Kaltani, and Loayza (2005) use panel data instead of a cross-section and trade shares corrected for country size are their measure of openness. In their work, the key complementary policies for ensuring that openness to trade is associated with growth include infrastructure development, labor market flexibility, and low barriers to entry. Given the current levels of those variables, they conclude that "there are many countries that currently stand to lose from opening their markets". Chang, Kaltani and Loayza argue that other types of reforms are not so critical for ensur-

ing growth gains from openness, including educational attainment, financial depth, and good governance. DeJong and Ripoll (2006), using tariffs as a measure of openness, also find that the effect of openness on growth is conditional on the level of income. In particular, using cross-country data for 1975-2000, they find a positive relationship between tariffs and growth rates for the world' poorest countries, but a negative relationship for rich countries.

These three papers have several implications for trade policy. When first-best outcomes (eliminating both trade and other distortions simultaneously) are not possible, these papers suggest that the advisability of trade reform depends on the existence and the degree of non-trade distortions and the feasibility of removing them. Policy makers need to reject a "one size fits all" approach to trade opening in favor of packages tailored to the specific circumstances of each country. Another implication is that opening up to trade is not enough; in particular, key complementary reforms include lowering barriers to new firm entry, encouraging more flexible labor markets, and improving infrastructure.

4.3 What can the different effects of trade volumes versus trade policy tell us about the success of IP?

Our review of recent evidence on trade policies, trade volumes, and growth suggests that researchers face several challenges. In particular, measuring openness to trade, identifying the direction of causality between openness and growth, and identifying additional controls to include in cross-country estimation are ongoing concerns. Nevertheless, our review of the studies in Table 2 suggests the following broad conclusions:

- Studies that use trade volumes as a measure of openness generally find a positive relationship between changes in openness and growth.
- Studies that use tariffs as a measure of openness for the post World War II period generally find an insignificant effect of average tariffs on growth. However, the pattern of protection matters. High tariffs on intermediates or investment goods may be negatively associated with growth.

Existing studies suggest that in the post World War II period, tariffs on average have not been successful in generating higher growth. We confirm

these general conclusions using a panel dataset on non-OECD countries, for the 1960 through 2000 period. In particular, we contrast the results using trade shares (X+M/GDP) as our openness measure relative to using the World Bank's revenue tariffs (tariff revenue divided by imports). The dependent variable is log income per capita. The use of a panel of annual observations allows us to control for country-specific fixed effects and also for time effects. Country fixed effects are one approach to controlling for country characteristics that vary across countries (such as institutions) that are not perfectly measured and do not vary systematically from one year to the next. Time effects allow us to control for world-wide shocks, such as an oil price shock or a world–wide currency crisis.

The top two rows in Table 5 show that openness measured using trade shares is positively and significantly associated with growth. These results are consistent with the majority of the studies listed in Table 2 that use trade shares as a measure of openness and generally find that changes in trade shares are associated with higher growth. However, the bottom two rows show that revenue tariffs are not significantly associated with growth. Even skeptics, such as Rodriguez (2007), generally conclude that there is a strong correlation between trade volumes and growth, while the association between trade policy–as measured by the World Bank's revenue tariff measure–and growth is weak.

The positive correlation between trade shares and growth is very strong and remains after we add other controls. The negative correlation between tariffs and growth is significant in some specifications but is not a robust finding; even Estevadeordal and Taylor (2008) find no correlation with growth when using consumption goods tariffs as a measure of openness. What should we make of this? As we discussed in Section 3, tariffs are imposed for many reasons. Foremost among these reasons are the need to raise revenue, political economy considerations, and infant industry concerns. Either IP via protection has not worked, or protection on average has been imposed for other reasons, leading to no net gains in output.

A promising area for new research is to move beyond reduced form evidence on the linkages between openness and growth so that we can identify *how* openness to trade affects growth. This is particularly important from a policy perspective. If openness yields benefits because it allows firms to import new technology embodied in capital goods, the policy implications are quite different than if openness is beneficial because it forces firms to compete internationally or leads to market share reallocation towards more

efficient firms. Identifying the mechanisms leading from openness to growth is precisely the focus of new micro-based studies of firms (see, for example, Melitz (2003) or Acemoglu, Antras, and Helpman (2007)). These theoretical advances have been accompanied by a growing empirical literature, to which we now turn.

4.4 Identifying the mechanisms for gains from trade

Much of the new research evaluates the importance of international trade for growth using micro models of consumer and firm behavior. This new research focuses on the following mechanisms for understanding the linkages between openness to trade and growth: (1) gains from consumption of increased variety (2) gains from importing goods that embody new technology (3) gains from increasing competition (4) gains from reaping economies of scale (5) gains through reallocation of market shares to the most productive firms and (6) learning by doing through exporting. We describe these in more detail below.

Gains from consumption of increased variety Quantitative models are useful for measuring gains from trade coming from increased variety, as in Romer (1994). Romer (1994) and Feenstra (1994) showed that these gains could be large, while Arkolakis et. al. (2008) show that Romer's results are sensitive to modeling assumptions. Under heterogeneity, gains could be small, as the new varieties that are imported after liberalization are "marginal varieties," in the sense that total consumption of these goods is small. Moreover, the benefits from the increase in foreign varieties could be compensated by the losses associated with the displacement of domestic varieties. Another important paper in this literature is Broda and Weinstein (2006). Broda and Weinstein show that an important part of growth comes from the increase in imported variety over the last decades. While this may in part result from a country's own trade reforms, it is also driven by diversification on the part of exporting countries like China.

Gains from importing goods that embody new technology Eaton and Kortum (1999) argue that tariffs affect the price of capital, and through this they affect the capital-labor ratio in steady state. Coe and Helpman (1995), Keller (1998) and others reviewed in Keller (2004) study the role of trade as a vehicle for "international R&D spillovers." The idea is that by importing intermediate and capital goods, a country benefits from the R&D done in the exporting countries. This is a key feature of the model of R&D and trade

in Eaton and Kortum (2001). A different notion is that trade accelerates the international flow of technical know-how (see Grossman and Helpman, p. 165). Several papers have explored this empirically with mixed results (see Rhee et. al., 1984, Aitken et. al., 1997, and Clerides et. al., 1998, and Bernard and Jensen, 1999).

A number of theoretical papers have explored the role of intermediate inputs in raising productivity growth (Ethier (1979,1982), Markusen (1989), Romer (1987, 1990), and Grossman and Helpman (1991)). Some recent studies find that increasing intermediate goods inputs or lowering input tariffs are associated with large productivity gains. This includes Goldberg, Khandelwal, Pavcnik, and Topalova (2008), Kasahara and Rodrigue (2008), Amiti and Konings (2007), Halpern, Koren, and Szeidl (2006) and Broda, Greenfield and Weinstein (2008). Goldberg, Khandelwal, Pavcnik and Topalova (2008) use Indian data to show that accounting for new imported varieties lowered the price index for intermediate goods by 4.7 percent per year relative to conventional gains from lower import prices. They also find that lower input tariffs account for a third of the new products introduced by domestic Indian firms, suggesting potentially large gains from trade.

Ramondo and Rodríguez-Clare (2008) develop a model in which countries interact through trade and multinational production (MP). MP can be seen as a particular way through which technology diffuses across countries. Trade and MP are substitutes in that they are alternative ways to serve a market, but they are also complements because MP requires importing inputs from the home country. The authors estimate the model and then conduct counterfactual exercises to study the gains from trade and MP. In preliminary calculations they find that trade and MP act more as substitutes than complements. This would imply that the calculated gains from trade do not increase when we take into account the indirect effect of trade in facilitating technology diffusion through MP. Still, the joint gains from trade and MP are very large, particularly for small countries.

Gains from increasing competition Levinsohn (1993), Harrison (1994), and Muendler (2005) show that increasing competition due to lowering of trade barriers reduced price-cost margins, using micro-level data for Turkey, Cote d'Ivoire, and Brazil. Enhanced competition may encourage firms to engage more in innovative activity, or may simply lead to lower prices for consumers. One important implication is that studies which measure the productivity gains from trade reforms without allowing mark-ups to fall post reform are likely to mismeasure the productivity gains from trade, as pointed

out by Harrison (1994). Harrison shows that the direction of the bias in productivity measurement cannot be identified *a priori*. She also shows that a simple way to address this problem is to allow measured factor shares to vary with changes in trade policy when doing production function estimation.

Gains through reallocation of market shares to the most productive firms New heterogeneous trade models suggest that trade enhances productivity by reallocating output towards more efficient firms. In the original framework developed by Melitz (2003), firms are endowed with different productivity draws, which are pre-determined and unchanging over time. When a country opens up to international trade, only the more productive firms remain as the less productive firms are forced to exit.

There are a number of implications of this framework which could be tested using firm-level data. As we discussed earlier, these models which emphasize reallocation of firm shares imply a critical role for other complementary policies that make it easy for firms to expand, contract, enter, or exit the market. Another implication is that productivity gains from trade reforms should operate through market share reallocation. An early study for the United States by Baily, Hulten, and Campbell (1992) did not focus on trade policy *per se* but provided a framework for decomposing productivity growth into components due to within-firm changes versus reallocation of output. They concluded that the bulk of growth in aggregate total factor productivity (TFP) was accounted for by the reallocation of output shares. For developing countries, this decomposition has been performed by Pavcnik (2002) for Chile and by Van Biesebroeck (2003) for Colombia.

Since Pavcnik's sample begins at the end of the Chilean trade reforms, she cannot use changes in trade policy as her openness measure. Instead, she separates enterprises into import-competing, export-competing, and non-traded sectors. She then examines whether import or export-competing firms had higher productivity relative to other types of firms. Using the Olley-Pakes (1993) approach to estimating productivity, Pavcnik finds that import competing firms improved their productivity over time, while export competing firms did not. This suggests that in Chile there was no learning among exporters, but import-competing firms did exhibit productivity growth. Pavcnik calculates that two-thirds of productivity growth in Chile was due to reallocation of market shares towards more efficient producers, and the remaining one-third was due to improved productivity among surviving firms.

Van Biesebroeck (2003) uses a variety of methods to compute productivity

growth and finds that for Colombia the majority of changes in productivity occur within the same plant. Van Biesebroeck finds that between two thirds and three quarters of the total change comes from within plant changes. The second most important effect is the entry of more productive plants into the economy. While Pavcnik (2002) finds that two-thirds of the increases in productivity growth are due to reallocation of market shares, Van Biesebroeck finds the opposite: in Colombia, the bulk of aggregate increases in productivity growth are driven by within-plant changes in productivity.

One possible explanation for these different results is that entry and exit barriers (due to restrictions on hiring and firing) in Colombia were higher than in Chile during this period. Barriers to entry or exit make it difficult for a reallocation of market share towards more efficient producers to occur. More case studies are needed before we can reach any definitive conclusions. However, the limited evidence suggests that productivity growth stems from *both* (1) a reshuffling of production towards more efficient producers and (2) increasing productivity within the firm. Consequently, Melitz's (2003) simplifying assumption that firms receive an exogenous productivity draw which is unchanging over time is not consistent with actual firm behavior. The latest heterogeneous firm research modifies Melitz (2003) to allow firm-level productivity to evolve over time, instead of being fixed at the initial distribution. Atkeson and Burstein (2006), Costantini and Melitz (2007), Lileeva and Trefler (2007), and Ederington and McCalman (forthcoming) all develop models with heterogeneous firms where productivity is allowed to evolve within the firm. Lileeva and Trefler (2007) allow reductions in foreign tariffs to induce lower-productivity firms to invest in raising labor productivity, engage in more product innovation, and increase their adoption of advanced manufacturing technology, which in turn leads to within-firm productivity gains. Bernard, Redding and Schott (2006) have also developed a model where firms produce multiple goods, and trade liberalization may lead them to focus on the goods in which they are most productive. Empirically this would be seen as an increase in productivity within firms, even though the mechanism is essentially the same as in Melitz (2003).

Learning by doing through exporting One likely channel through which international trade leads to productivity gains is through learning by doing for exporters. Yet a first round of empirical studies suggested that there was very little, if any, learning from exporting. Instead, these first generation studies found that the best firms select into exporting, leading to a strong positive correlation between productivity levels and export status.

This research included case studies of Colombia (Clerides, Lach, and Tybout (1998)), Spain (Delgado, Farinas, and Ruano (2002)), Germany (Bernard and Wagner (1997)),and the United States (Bernard and Jensen (1999)). Pavcnik (2002) also found a similar result: firms operating in export-competing sectors are the most efficient in manufacturing, but these firms do not show productivity improvements over time.

This first-generation evidence is drawn from primarily high and upper middle income countries. A second wave of empirical studies casts doubt on the hypothesis that there is no learning by doing for exporters. For developing countries, this includes Aw, Chung, and Roberts (2000) for Korea, Van Biesebroeck (2005) for 9 African countries, Lileeva (2004), Blalock and Gertler (2004) for Indonesia, Hallward-Driemeir, Iarossi, and Sokoloff (2005) for East Asian countries, Fernandes and Isgut (2006), Park, Yang, Shi and Jiang (2006) for China, Aw, Roberts and Winston (2007), and De Loecker (2007) for Slovenia.

All of these second generation studies find evidence of learning through exporting. Blalock and Gertler (2004), for example, test for whether exporting confers productivity gains using a panel of Indonesian manufacturing enterprises. They find strong evidence that firms experience a jump in productivity of 3 to 5 percent following the initiation of exporting. Van Biesebroeck (2006) examines the evidence in favor of learning by exporting in Africa and also finds a causal link from exporting to productivity.

Blalock and Gertler argue that previous tests of learning by exporting were done on industrialized or middle income developing countries. They point out that "while firms in developed and middle income countries are likely to be as efficient as those in their trading partners' countries, firms in the poorest countries may have much more to gain from exposure to international export markets". Lileeva and Trefler (2007) propose a similar explanation for these disparate findings using Canadian data. They show that lower productivity firms are more likely to invest and learn in order to access foreign markets, in contrast to higher productivity firms that are able to export without additional investment. De Loecker (2007) finds that for Slovenian firms, there was evidence of a different kind of selection into export markets: only the most productive firms began exporting. He then uses nonlinear matching estimation to test whether there was learning by exporting during the 1994-2000 period. He finds that while there was evidence of selection into export markets, these same exporters increased productivity as a result of exporting. The identification strategy uses both matching

techniques and the difference in productivity growth for those who began exporting this period relative to a control group that did not. De Loecker also finds that learning by exporting was higher for firms exporting to high income destinations.

All of the identification problems present in (10) for the cross-country literature are challenges for these micro studies as well. How can we distinguish between selection into exporting (i.e. the most productive firms choose to become exporters) and the impact of exporting on learning and productivity? A number of studies exploit the panel nature of the data, testing whether firms were more productive prior to becoming exporters. This involves constructing an indicator for the period prior to when the firm becomes an exporter and testing whether it is statistically significant in a regression of productivity on export status. Another approach has been to find an instrument for export status. Van Biesebroeck (2005) uses as instruments for lagged export status the location of the firm, ethnicity of the owner, foreign ownership and state ownership, although the validity of these instruments is not completely clear. Lileeva and Trefler (2007) use US tariff cuts mandated by the Canada-US Free Trade Agreement as an instrument for Canadian export status.

Despite ongoing controversies regarding the importance of learning by doing through exporting, it is probably safe to conclude the following:

1. The most productive firms are likely to become exporters.

2. While there is selection into exporting, there is also learning through exporting.

3. Learning from exporting is most likely in technologically backward countries and among less productive firms.

5 Foreign Direct Investment

Many countries encourage inward FDI because they expect that foreign firms will enable domestic enterprises to become technologically more advanced. This is nothing other than industrial policy, although it is rarely identified as such. As pointed out in our introduction, attracting foreign funds typically means tilting incentives in favor of foreign investors. Hanson (2001) reviews the many incentives offered to foreign firms, which include income

tax holidays, tariff exemptions, and subsidies for infrastructure. In 1998, 103 countries offered tax concessions to foreign companies that set up production or other facilities within their borders. Some of these concessions were enormous: the Government of Alabama paid the equivalent of 150,000 dollars per employee to Mercedes for locating its new plant there in 1994; the British government provided between 30,000 and 50,000 dollars per employee to attract Samsung and Siemens in the late 1990s; Ireland offered until recently a corporate tax rate of 10 percent to all foreign manufacturers who chose to locate there (Gorg and Greenaway (2003)). Until 2008, China offered significantly lower corporate tax rates to foreign companies locating there, and continues to subsidize infrastructure investments for multinationals locating in foreign enterprise zones.

Most countries encourage FDI inflows to specific sectors; typically these are sectors which are technologically more advanced. Chandra and Kolavalli (2006) document that "attracting FDI has been an important strategy in technological adaptation" in a number of cases (p. 33) Table 6 from Alfaro and Charlton (2008) identifies the specific sectors targeted by 29 countries for the 1985-2000 period. The most targeted sectors include machinery, computers, telecommunications, and transport equipment.

Alfaro and Charlton find that FDI inflows are likely to be higher in targetted sectors, and that FDI in these sectors generates higher growth. Their study suggests some support for the argument that IP has been successful for FDI, possibly because governments appear to target sectors with positive externalities. Nevertheless, it is difficult to econometrically identify whether targeting has worked, since FDI may be attracted to sectors with high potential growth.

Aggregate cross-country studies on FDI and growth are reviewed in greater detail in another chapter of this volume. Given the strong correlation between FDI inflows as a share of GDP and openness to trade reported in Tables 3 and 4, identifying a separate impact of FDI from trade on country outcomes is likely to be challenging. All of the problems associated with the cross-country evidence on trade and growth—measuring policies, identifying the direction of causality, and omitted variable bias–are present in this literature as well. Researchers typically use FDI flows, rather than policies targeted at FDI, to measure its effects, since panel data on FDI policies is even more difficult to obtain than data on tariffs. Reverse causality is also a problem, since extensive evidence suggests that FDI is attracted to large, less risky, and growing local markets. Nevertheless, there is generally mixed

evidence on the relationship between FDI and a country's growth (Carkovic and Levine (2002), Bosworth and Collins (1999), Borenzstein et al (1998)). Recent work on FDI and growth suggests that other complementary policies need to be in place to maximize the gains from inward foreign investment, reinforcing the theme introduced in Section 4 on trade. Important policies that need to be in place for a country to benefit from FDI include a minimum level of human capital (Borenzstein et al, 1998), developed financial markets (Alfaro et al, 2004) and openness to trade (Balasubramanyam, Salisu, and Dapsoford, 1996).

There is significant research interest in FDI as a vehicle through which developing country firms learn about new technology. While most of the empirical literature focuses on productivity effects of FDI, there is also a growing literature that examines the impact of FDI on factor markets. We review these two research areas below.

5.1 FDI and Productivity

To justify special treatment, foreign enterprises would need to confer some type of positive externality which is not internalized by firms. A typical test of whether foreign firms transfer technology to domestic enterprises would be to estimate firm-level productivity, and measure whether a more extensive foreign presence increases domestic firm productivity. As an illustration, Aitken and Harrison (1999) estimate the following production function for firm i in sector j at time t:

$$\begin{aligned} Y_{it} &= \text{Constant} + \beta_1 DFI\_Plant_{ijt} + \beta_2 DFI\_Sector_{jt} \\ &\quad + \beta_3 \left(DFI\_Plant_{ijt} * \beta_2 DFI\_Sector_{jt} \right) + \beta_4 Z_{ijt} + \alpha_i + \tau_t + \varepsilon_{it} \end{aligned}$$

where

$$DFI\_Sector_{jt} = \frac{\sum_{i \in j} DFI\_Plant_{ijt} * Employment_{ijt}}{\sum_{i \in j} Employment_{ijt}}$$

The dependent variable could be log of output, in which case the Z vector would control for input use, leaving foreign investment to affect the residual determinants of output, which is typically interpreted to be total factor productivity (TFP) levels. Alternatively, the dependent variable Y could be output per worker or TFP, and the vector Z could include a number of

other controls, such as size, openness, or other determinants of productivity. DFI_Plant is typically measured as the share of the plant which is foreign-owned. The coefficient β_1 then measures whether firms with foreign investment are more productive than other plants. Most researchers find that the own-plant effect is large and significant. In other words, firms with foreign equity participation typically have higher output, higher output per worker, or higher levels of TFP.

This is an important point which has not been emphasized enough in the literature on FDI. While many researchers are focused on identifying some sort of externality or technology spillover, probably the most important contribution that foreign firms make is the direct effect captured by the coefficient β_1 on DFI_Plant. Ramondo (2008) develops a model where countries gain access to foreign technologies through the activities of multinationals. In counterfactual exercises with her estimated model she finds that for small countries the associated benefits can be quite large.

If most benefits from FDI are internalized by receiving plants, then promoting joint ventures is important for policy. Promoting joint ventures has been the core of China's policy to benefit from inward foreign investment. Foreign investors in key sectors (mobile phones, computers) were required to enter into joint ventures with domestic firms (Rodrik, 2006). In electronics, Huchet (1997) writes that China's technology strategy has been clear: "allow foreign firms access to the domestic market in exchange for technology transfer through joint production or joint ventures." Wholly owned foreign firms are a rarity in China; most firms are joint ventures between local (frequently state-owned) and foreign enterprises.

China is a particularly interesting case to study in seeking to understand the role played by technology transfer via FDI. Since opening its economy to the outside world in late 1978, China has absorbed an increasing amount of FDI and is now among the world's largest hosts of FDI inflows. A number of recent papers use Chinese firm-level data to evaluate the the own-plant effect (the coefficient β_1 that measures whether firms with foreign investment are more productive than other plants). All these studies, including Hu and Jefferson (2002), Du, Harrison, and Jefferson (2008), and Lin, Liu, and Zhang (2008) find that joint ventures in China exhibit not only higher productivity levels than other enterprises but also higher productivity growth. Du, Harrison, and Jefferson (2008) find that these effects are largest for state-owned enterprises that form partnerships with foreign firms. The impact on their productivity is 10 times that on privately-owned enterprises. Du, Har-

rison, and Jefferson (2008) suggest that forming joint venture partnerships for Chinese state-owned enterprises has provided an alternative approach to privatization as a way of increasing public sector performance. Bartel and Harrison (2004) also find that public sector enterprises in Indonesia improved performance after forming joint ventures with foreign enterprises.

Although there is a strong relationship between foreign ownership and productivity levels, that effect often cannot be separately identified from a firm fixed effect. So if the equation above is estimated either in first-differences or with firm specific effects, then the coefficient on DFI_Plant may not be significant. What this implies is that firms with foreign equity participation are at a higher level of technology, but technological change is not always higher for these enterprises. This should not be surprising, since many of these firms are already at the technology frontier.

While evidence suggests that it might make sense to encourage less productive state enterprises to make alliances with foreign firms, or to provide incentives for firms to form partnerships with foreign firms, most research has not used any sort of identification strategy to tease out the direction of causality. One possibility is that foreign firms acquire the most productive domestic enterprises, or form alliances with the most productive firms. Arnold and Javorcik (2006) attack this problem by asking whether foreign firms are simply acquiring the most productive domestic enterprises (in Indonesia) or whether they cause these enterprises to become more productive. Combining differences-in-differences estimation with nonlinear matching techniques, they show that the acquired firms outperformed the control group in every observable dimension, including exhibiting higher productivity growth, higher investment, and higher sales growth. They conclude that foreign equity infusions do confer benefits to domestic enterprises, and that the effect is not simply one of picking winners. However, more studies in this regard would be useful.

The coefficient β_2 on DFI_Sector measures the extent to which foreign ownership in the sector positively affects the productivity of domestic enterprises. This effect is sometimes referred to as a horizontal spillover, since it measures the extent to which foreign investment in the same sector affects the productivity of domestic firms. Early studies, such as Blomstrom and Wolff (1994) for Mexico, typically estimated a pure cross-section or failed to include firm or industry-specific effects. Consequently, the coefficient β_2 was always positive and frequently significant, indicating the presence of positive horizontal spillovers. Aitken and Harrison (1999) showed that this positive

coefficient for Venezuelan manufacturing enterprises was spurious, indicating that foreign firms were attracted to highly productive sectors. When they include firm or sector effects, the coefficient on DFI_Sector switched from positive to negative. Aitken and Harrison interpreted the negative coefficient as indicative of market-stealing: foreign firms grab market share from domestic firms, driving them up their cost curves in sectors with economies of scale.

Other recent studies measuring the extent of horizontal spillovers are listed in Table 7. In contrast to earlier studies which generally found support for positive (horizontal) spillovers, more recent studies that have attempted to reproduce Aitken and Harrison (1999) for other countries have typically found insignificant or negative horizontal externalities. This includes Djankov and Hoekman (2000) for the Czech Republic, Smarzynska (2002) for Lithuania, Lopez-Cordova (2003) for Mexico, Damijan et al (2001) for eight transition economies, Kathuria (2000) for India, Hu and Jefferson (2002) and Du, Harrison and Jefferson (2008) for China, and others. Virtually every study published since 1999 has found negative or insignificant horizontal externalities.[30]

One explanation for the lack of positive horizontal spillovers is that foreign firms have no incentives to transfer knowledge or technology to competitors within the same industry. They should, however, have an incentive to help the productivity of their suppliers, by transferring knowledge to them (see Kugler (2001)). More recent work has sought to identify what is now referred to as vertical spillovers, which are positive externalities stemming from the relationships of foreign enterprises with domestic suppliers or customers. Forward spillovers could occur if foreign firms that locate domestically supply inputs that embody new technologies or processes. Backward spillovers could occur if domestic suppliers to downstream foreign firms benefit from contacts with the firms to increase productivity. Smarzynska (2004) defines horizontal, forward, and backward FDI spillovers as follows:

$$HorizontalFDI_{jt} = \frac{\sum_{i \in j} DFI\_Plant_{ijt} * OUTPUT_{ijt}}{\sum_{i \in j} OUTPUT_{ijt}}$$

[30] One interesting exeption in Poole (2008), who uses a matched establishment-worker database from Brazil to present evidence consistent with the existence of positive multinational spillovers through worker mobility in Brazil.

and

$$ForwardFDI_{jt} = \sum_{m \neq j} \sigma_{jm} \frac{\sum_{i \in m} DFI\_Plant_{ijt} * (Y_{ijt} - X_{ijt})}{\sum_{i \in m} (Y_{ijt} - X_{ijt})}$$

where σ_{jm} is the share of inputs purchased by industry j from industry m in total inputs sourced by sector j. Finally, if α_{jkt} is the proportion of sector j's output that is supplied to sector k (taken from the input-output matrix), then backward FDI spillovers are defined as:

$$BackwardFDI_{jt} = \sum_{k \neq j} \alpha_{jk} * HorizontalFDI_{kt}$$

Smarzynska finds a zero or negative impact from forward linkages, and a positive impact of backward linkages, indicating that technological gains from FDI are primarily concentrated among domestic suppliers interacting with downstream foreign firms. Recent studies on other countries (Table 7) also find these positive backward FDI spillovers, including Blalock and Gertler (2003) for Indonesia, Liu for China (2005), Gorodnichenko, Svejnar, and Terrell (2006) for 15 transition economies, and Lopez-Cordova (2003) for Mexico. The evidence in favor of backward spillovers may be one factor that could explain China's emphasis on the use of domestic content requirements. Sutton (2004) describes the use of domestic content requirements in both India and China as follows:

> "From the early '90s onwards, a wave of multinational firms entered both markets. In both countries, these entrants were required to achieve a high level of domestic content within a specified period (typically, 70 percent within 3 years). For at least some of the new entrants, this was seen as an unreasonable target, as domestic suppliers could not meet the price and quality requirements of the car makers. Achieving the 70 percent target required the car makers to switch rapidly from a reliance on imported components to sourcing from local vendors; and this in turn gave the car makers a strong incentive to work closely with (first-tier) suppliers, to ensure that quality standards were met, within an acceptable price."

These requirements illustrate how IP has been actively used to shape China and India's auto sector through the use of domestic content requirements. Even if there are backward spillovers, however, the optimal policy would be to subsidize domestic input purchases by foreign firms instead of imposing them through domestic content requirements. Domestic content requirements could deter some investments that would have created backward spillovers, and may lead to inefficient outcomes by protecting domestic suppliers from import competition.

Perhaps as a result of very demanding domestic content requirements, recent efforts to identify backward FDI spillovers in Chinese manufacturing have found none. These include studies by Du, Harrison, and Jefferson (2008), and Lin, Liu, and Zhang (2008). Both studies use firm-level manufacturing census data spanning 1998 through 2006. Lin, Liu, and Zhang (2008) find evidence of positive forward spillovers, while Du, Harrison, and Jefferson (2008) find negative horizontal spillovers and positive forward spillovers. A remaining question for researchers is why there are backward spillovers in other countries but not in China.

A related approach is to think of the benefits of FDI through their impact on the variety of non-tradable inputs available in the host country. Rodríguez-Clare (1996) presents a model to explore this idea. Under full employment, multinationals expand at the expense of domestic firms, so what matters is the demand for domestic inputs per unit of labor hired, a term that Rodríguez-Clare labels the *linkage coefficient*.[31] If multinationals' linkage coefficient is higher than that of domestic firms, the multinationals' backward linkage effect is positive and FDI would lead to an increase in input variety and host-country productivity.[32]

Using firm-level data for several Latin American countries, Alfaro and Rodríguez-Clare (2004) show that although multinationals source a lower share of their inputs domestically than domestic firms, they nevertheless tend to have a higher linkage coefficient thanks to the fact that they use more roundabout production methods, requiring more inputs per unit of labor. Still, to date there is only anecdotal evidence that multinationals indeed lead to an increase in the variety of inputs available in the host country. Moreover, one concern is that if multinationals generate positive backward linkages then

[31] This is in contrast to most of the literature on multinationals and linkages, which focused instead on the share of inputs that multinationals source domestically.

[32] The positive productivity effect relies on the presence of love of variety for inputs, as in Ethier (1982) and Romer (1990).

this should benefit domestic firms that use similar inputs as multinationals. One would then expect to see positive horizontal externalities, but this is generally not what the literature finds (at least in LDCs).

To summarize, the evidence seems to consistently indicate that:

1. Firms that receive FDI (joint ventures) or are acquired by multinationals generally exhibit higher productivity levels.

2. There is evidence of positive vertical spillovers from foreign buyers to domestic suppliers (backward linkages) and from foreign suppliers to domestic buyers (forward linkages).

3. There are negative or insignificant horizontal spillovers to firms within the same industry.

Anecdotal evidence and new research (Chandra and Kolavalli (2006), Alfaro and Charlton (2008)) suggests that FDI has been particularly important in cases where governments were actively engaged in strategies of technological upgrading in certain sectors, and brought in foreign companies as part of those strategies. Typically, these efforts were part of a set of complementary policies that included increasing the supply of skilled workes in a targetted industry, improving regulation and infrastructure, promoting new activities and innovation, and increasing exports. In many of those cases, the government probably encouraged joint ventures, but the direction of causality is not so clear.

Given these results, are fiscal incentives for foreign enterprises warranted? If the primary reason for giving these incentives is to encourage technology transfer, then the answer should probably be no: if foreign firms are the only ones that use the inputs that benefit from backward spillovers and there are no horizontal spillovers, then there is no need to subsidize FDI. Yet there is clearly a further need to understand the mechanism through which foreign firms generate vertical spillovers. Even if vertical spillovers do exist, Pack and Saggi (2006) argue that "the magnitude of some of the incentives being used seems difficult to justify". (p. 281). They also point out that "investment incentives and tax breaks to multinational investors work against their local competitors. Thus, if there are local firms that could potentially compete with multinationals, the adverse effect on such firms of tax incentives to multinationals needs to be taken into account. The efficacy of investment incentives is also unclear—such policies could easily end up transferring rents

to foreign investors without affecting their investment decisions." (Pack and Saggi (2006), p. 281)

5.2 FDI and host country factor markets

One robust result in the literature on foreign ownership and productivity is that firms with foreign equity have higher productivity levels. Foreign firms are also typically more capital intensive, and spend more on worker training. As long as firms do not face a perfectly flat labor supply schedule, it is likely that these different firm characteristics will translate into higher wages. There could also be other imperfections in the labor market, such as search costs for firms seeking skilled wages, or efficiency wage setting, that could result in foreign firms paying higher wages. To the extent that there is worker mobility or productivity spillovers, these wage effects for workers at foreign enterprises could also spill over to other workers.

Almost all studies find that workers in foreign firms are paid higher wages, which may reflect the fact that foreign firms or joint ventures have higher productivity levels. In perfect markets more productive firms would not pay higher wages, but market imperfections (such as search costs or informational asymmetries) could generate such a link. Evidence showing higher wages paid by multinationals includes Aitken, Harrison and Lipsey (1996) for Mexico and Venezuela, Lipsey and Sjoholm (2004) for Indonesia using a pure cross-section, Harrison and Scorse (2004) for Indonesia using a panel, Velde and Morrisey (2003) for a set of African economies, Martins and Esteves (2007) for Brazil, and Earle and Telegdy (2007) for Hungary. Studies of industrial countries also find large wage gaps between domestic and foreign enterprise wages when researchers do not condition for worker or firm characteristics. This includes Almeida (2003) for Portugal, Girma, Greenaway and Wakelin (2001) and Driffield and Girma (2003) for the United Kingdom, and Feliciano and Lipsey (1999) for the United States. The unconditional wage gap, which is the gap in wages paid by foreign versus domestically owned enterprises without controlling for worker or firm characteristics, is typically large. It is frequently as high as 40 percent (for Hungary) or 50 percent (for Brazil).

When researchers control for worker and firm characteristics, then the wage premium paid by foreign firms declines dramatically, to around 10 percent. Earle and Telegdy (2007) find that the wage gap between workers employed at foreign and domestic enterprises is not much affected by conditioning on worker characteristics, but that controlling for industry reduces

the premia to 34 percent, and controlling for firm size further reduces it to 28 percent. (Robert Lipsey has questioned whether it makes sense to control for characteristics such as firm size: if foreign firms are larger and consequently pay higher wages than domestically owned enterprises, workers are nevertheless better off.) When Earle and Telegdy control for unobserved fixed effects by exploiting changes in firm ownership to identify its effect on wages, the premium is further reduced to 7 percent. Harrison and Scorse (2004) also find that the premium falls to between 5 and 10 percent when worker and firm characteristics are controlled for. Ibarraran, using data for Mexican macquilas in 1992 and 1999, finds no premium in 1992 but a small premium in 1999.

Martins and Esteves (2007) use matched worker and firm panel data for 1995 through 1999 to analyze the impact of foreign ownership on wags in Brazil. Like Earle and Telegdy (2007) they use changes in firm ownership as a way to control for unobserved firm-specific effects that could be correlated with wage premia. They also follow workers who move to or leave foreign enterprises, to control for unobserved worker-specific effects. They find that workers moving from foreign to domestic firms typically take wage cuts when they move, while movers form domestic to foreign firms increase their pay. However, compared to the unconditional wage gaps of 50 percent, the wage premium associated with working for a foreign firm falls to between 3 and 7 percent once worker and firm characteristics are controlled for. The authors conclude that their results support a positive view of the role of foreign firms upon the Brazilian labor market.

To summarize, the evidence suggests that foreign firms pay a small wage premium of between 5 and 10 percent. While the earlier literature found larger wage premia of more like twenty percent, these earlier estimates failed to adequately control for individual characteristics of workers, such as education and experience. Consequently, part of the wage gap stems from the fact that foreign firms tend to hire better educated and more skilled workers. Nevertheless, we can safely conclude that foreign enterprises do not unfairly "exploit" workers, paying them below what their domestic counterparts would pay. In fact, most of the evidence suggests that foreign firms tend to pay higher wages than comparable foreign firms. There is also evidence that foreign firms are more susceptible to pressure from labor groups, leading them to be exhibit greater compliance with minimum wages and labor standards. Harrison and Scorse (2008) find that foreign firms in Indonesia were much more likely than domestic enterprises to raise wages and adhere to min-

imum wages as a consequence of the anti-sweatshop campaigns there. They also find that the employment costs of the anti-sweatshop campaigns were minimal, as garment and footwear subcontractors were able to reduce profits to pay the additional wage costs without reducing the number of workers.

While most of the emphasis on the role of FDI in local factor markets is on the relationship between FDI and host country wages, there is also an emerging literature on FDI's effect on local capital markets. One reason policy makers give for promoting foreign investment in developing countries is the scarcity of capital for new investment. This argument is based on the assumption that incoming foreign investors provide additional capital when they set up new enterprises in local markets. However, as exchange rate volatility has continued to rise many foreign investors have found ways to hedge by borrowing on local capital markets. This increase in local financing for incoming foreign investors may lead to crowding out of domestic firms.

Harrison and McMillan (2003) and Love, Harrison, and McMillan (2004) test whether or not borrowing by local multinationals is crowding out domestic enterprises. The framework in both papers uses an Euler equation approach combined with Generalized Method of Moment estimation. While Harrison and McMillan (2003) is a country case study which analyzes the behavior of mostly French multinationals operating in Cote d'Ivoire, Love, Harrison and McMillan (2004) use company level data across a panel of countries. The results suggest that in a country such as the Cote d'Ivoire, which was riddled with market imperfections and where access to credit was rationed due to interest rate ceilings, foreign investors did indeed crowd domestic enterprises out of local credit markets. However, Love, Harrison, and McMillan (2004) found that foreign investors tended to "crowd in" domestic enterprises—i.e., as foreign investment increased, the amount of credit available to domestically-owned firms actually rose. The contrasting results again point to the important role of policy complementarities: in a country with credit market imperfections such as the Cote d'Ivoire, FDI exacerbated these problems. These studies using micro-data are consistent with macro-level evidence on the importance of complementarities with financial market development for ensuring the gains from FDI (Alfaro et al, 2004).

6 Concluding Comments

Given the varied experiences across countries and time periods, the different interpretations possible, and the difficulties in conducting clean empirical analyses, it is not easy to arrive at strong conclusions regarding the role of industrial, trade and FDI policy in development. Our survey of the theory and the evidence nevertheless suggests some tentative conclusions.

We do not endorse infant-industry protection in this chapter; yet we do not claim that a somewhat uniform and moderate tariff is a disaster for development. There are instances where infant-industry protection was successful–particularly in the late nineteenth and early twentieth centuries–and could work today in developing countries. Still, the conditions needed for infant industry protection to succeed are generally not satisfied. The framework in Section 2 shows that the theoretical justification for intervention requires at a minimum either industry-level rents or a latent comparative advantage, as well as large Marshallian externalities from production. These necessary conditions are not easy to identify for policy makers ex ante. Nor is there evidence suggesting that developing countries have generally protected sectors with latent comparative advantage and Marshallian externalities. Most developing countries have the highest tariffs in consumer goods sectors, such as textiles and apparel. We suspect that the types of sectors where there are important Marshallian externalities are not those where developing countries have a latent comparative advantage (i.e., sectors that are intensive in knowledge and human capital). It is also likely that protection has been used as a tool to protect sunset industries instead of sunrise industries; hence, there is an inherent bias against promoting sectors with a latent comparative advantage.

For infant industry protection to improve welfare it must pass both the Mill and Bastable tests. The Mill test requires that the protected sector can eventually survive international competition without protection, whereas the Bastable test requires that the discounted future benefits compensate the present costs of protection. This means that the dynamic forces which increase industry productivity must operate quickly. In practice, most research assessing the success of IP has ignored these tests. There are other problems as well. In all the models presented in this review, protection is never the first-best policy. In addition, the infant-industry framework typically assumes that the mere expansion of a sector will generate all sorts of positive effects that will increase industry-wide productivity. But this may

not happen, and the economy may simply end up with a larger version of the inefficient sector it began with. We argue that it may be better to implement policies designed directly to elicit the investments that will increase productivity. Such investments may not occur without public intervention because of coordination failures.

While a number of market failures could justify government intervention in theory, the key question is whether IP has worked in practice. One challenge that we face in evaluating the empirical literature is the large gap between the theoretical justification for IP and the quantitative work that has been done to evaluate its "success". As we pointed out above,few studies of IP have examined whether industries pass either the Mill or the Bastable test. Even if studies could show that protected sectors grew faster, this would not be sufficient evidence to claim that IP is justified from a welfare standpoint. Nevertheless, we conclude that protection in the last several decades of the twentieth century generally failed to generate higher growth. The hundreds of studies on trade policies, trade shares, productivity and growth show a strong correlation between increasing trade shares and country performance, and no significant correlation between tariffs on final goods and country outcomes. The only exception is for intermediate or capital goods, where a higher tariff is associated with lower growth. Putting aside the serious problems of reverse causality identified in our review, we interpret this evidence as suggesting that trade and FDI policies are most successful when they are associated with increasing exposure to trade. One implication is that interventions that increase exposure to trade (such as export promotion) are likely to be more successful than other types of interventions (such as tariffs or domestic content requirements).

We remain skeptical that protection or subsidies to FDI are needed. Nevertheless, new evidence suggests that IP through FDI promotion may be more successful than intervention in trade, in part because FDI promotion policies focus on new activities rather than on protecting (possibly unsuccessful) incumbents. We are confident that if such measures are part of a broader effort to achieve technological upgrading then they may be helpful, whereas if they are implemented in isolation they are likely to fail. This is consistent with Chandra and Kolavalli (2006), who conclude their overview of ten cases of successful technology upgrading by stating that "the role of government was most effective when its support for specific industries was embedded in institutions and policies that were internally consistent, had an explicit purpose, and were blessed with political commitment" (p. 39). Rodrik refers to

this characteristic as "embeddedness". Chandra and Kolavalli conclude that "in every case, getting it right depended upon the degree of synchronization between institutions and government policies to motivate learning among exporters. The hallmark of these policies was industry specificity, which offers some useful lessons for other developing countries" (p. 41).

The long-running discussion about "picking winners" can be sidestepped by focusing on efforts of "discovery" (as argued by Hausmann and Rodrik, 2003), or by simply working with existing industries and clusters to deal directly with the coordination failures that limit their productivity and expansion. For example, instead of blanket subsidies for exports and FDI, we think of attracting multinationals to produce key inputs or to bring specific knowledge needed by clusters with the ability to absorb them. As Chandra and Kolavalli (2006) have put it, "without host-country policies to develop local capabilities, MNC-led exports are likely to remain technologically stagnant, leaving developing countries unable to progress beyond the assembly of imported components" (p. 19).

We envision an important role for what we refer to as "soft" industrial policy, whose goal is to develop a process whereby government, industry and cluster-level private organizations can collaborate on interventions that can directly increase productivity. The idea is to shift the attention from interventions that distort prices to interventions that deal directly with the coordination problems that keep productivity low in existing or raising sectors. Thus, instead of tariffs, export subsidies, and tax-breaks for foreign corporations, we think of programs and grants to, for example, help particular clusters by increasing the supply of skilled workers, encouraging technology adoption, and improving regulation and infrastructure. While "hard" IP is easier to implement than "soft" IP measures, tariffs and subsidies become entrenched and are more easily subject to manipulation by interest groups.

The specific policies that should be pursued as part of this type of IP depend, of course, on the particular coordination failures that affect a cluster. Given the variety of coordination failures that exist, there is a need for a wide set of instruments or policies. An exhaustive list is therefore impossible. Some examples are: regulation to enforce higher quality standards in cases of imperfect information or externalities; public investment in specific infrastructure projects when there are strong investment complementarities (e.g., a regional airport geared to exploit tourism opportunities, or an irrigation project for modern agriculture); attraction of FDI to bring in foreign technologies; scholarships for studies abroad in areas deemed important for

growth and diversification of a cluster in cases where thin markets prevent individuals from making such investments; grants for innovative projects proposed by single firms or entrepreneurs, prizes to innovative firms, grants for research projects proposed by organized producers and performed by local research centers, and technical assistance to allow long-term collaborative strategies for education and research between business associations and universities.

It is clearly unreasonable to expect governments to be able to identify the coordination failures affecting different sectors or clusters. A more realistic approach is to invite sector and cluster organizations to come forward with well-justified proposals for government support. It is instructive here to reproduce the practical advice of Altenburg and Meyer-Stamer (1999): "To meet the demands of globalized competition, intra-firm efforts are not sufficient. The business sector has to be able to organize collective action for self-help, and it must be able to articulate its demands vis-à-vis political actors. This places great demands on business associations, both in terms of service provision and lobbying. It implies a fundamental upgrading process and the creation of a learning organization. Key features are a professionalization of business associations (e.g., employing more and better qualified professionals) and the implementation of mechanisms to ensure ongoing organizational development." Perhaps the government should provide support to different sectors that want to start or improve their level of organization. This would be the first line of action in countries where the private sector organizations are weak or are designed for rent seeking or confrontation rather than constructive work.[33]

In comparison with the more traditional approach to IP, the soft IP that we propose here has two the additional advantages. First, although this requires more research, we conjecture that a soft IP reduces the scope for corruption and rent-seeking associated with hard IP such as protection or selective production subsidies. Second, soft IP is much more compatible with the multilateral and bilateral trade and investment agreements that many LDCs have implemented over the last decades. It is true that if an LDC wants to protect an industry for a period of time, it can always negotiate

[33] An example of such a process is the Macedonia Competitiveness Activity, a USAID-funded program that first motivated groups throughout the country to organize and propose cluster initiatives and then selected five such initiatives for support (see Ketels, 2006). Similar initiatives are currently being followed in other countries including Colombia, Chile, and the Dominican Republic.

"space" for that policy when it joins the WTO. This is warranted under the WTO's rules for Special and Differential Treatment (SDT), which call for "preferential market access for developing countries, limits reciprocity in negotiating rounds to levels 'consistent with development needs' and provides developing countries with greater freedom to use trade policies than would otherwise be permitted by GATT rules" (Hoekman, 2004, p.1). But if the country has already joined the WTO then this is not possible. Moreover, export subsidies are supposed to be eliminated by all but the poorest countries by 2015 (Agreement on Subsidies and Countervailing Measures), local content requirements on multinationals are now WTO-illegal (Agreement on Trade Related Investment Measures, TRIMS), and patent laws are supposed to be set according to international standards (Agreement on Trade Related Intellectual Property, TRIPS). Such restrictions make it impossible for LDCs to follow some of the policies implemented by South Korea and Taiwan, for example (Rodrik, 2004). Of course, as emphasized by Rodrik (2004), some policies associated with hard IP remain feasible: countries can provide fiscal incentives to particular sectors or to new activities. But clearly the policy space for hard IP has shrunk over the last decades, while that for soft IP remains basically unrestricted.

One area where additional research is urgently needed is on the human cost of adjustment to trade and FDI reforms. Although this was not the focus of our chapter, we note that there is limited research addressing how poor and unskilled workers are affected by trade reform and incoming FDI flows. Some preliminary evidence suggests that trade reforms may push workers towards the informal sectors (Goldberg and Pavcnik (2007),Muendler (2008)). To the extent that countries lack social safety nets, they may choose to delay liberalizing their trade or FDI policies. Harrison (2007) suggests that globalization is not inherently pro-poor, and that complementary measures are needed to cushion the impact and ensure that the gains from globalization are realized for everyone.

Appendix

We first show how size v_m matters for wages. We assume that $x_1 = x_2 = x$. Also, to simplify, we assume that $T_j = L_j = 1$ all j. In this case

$$\Phi_m \equiv \sum_j \hat{x}_{jm}^{\theta} w_j^{-\theta} \tag{11}$$

We also have $\hat{x}_{11} = \hat{x}_{22} = x$, while $v_1 > v_2$ and $\hat{x}_{j1} = \hat{x}_{j2} = z_j$ for any $j = 3, ...N$. Then it is clear that $\Phi_1 > \Phi_2 \iff w_1 < w_2$. Assuming to simplify notation that $Y = 1$ then

$$w_j^{1+\theta} = \sum_m \hat{x}_{jm}{}^{\theta} v_m / \Phi_m \tag{12}$$

Thus,

$$w_1^{1+\theta} = \sum_{m=3} \frac{v_m}{\Phi_m} + \frac{v_1}{\Phi_1} x^{\theta} + \frac{v_2}{\Phi_2}$$

and

$$w_2^{1+\theta} = \sum_{m=3} \frac{v_m}{\Phi_m} + \frac{v_1}{\Phi_1} + \frac{v_2}{\Phi_2} x^{\theta}$$

In equilibrium Φ_1 and Φ_2 solve the following system of equations

$$\begin{aligned}
\Phi_1 &= x^{\theta} \left(\sum_{m=3} \frac{v_m}{\Phi_m} + \frac{v_1}{\Phi_1} x^{\theta} + \frac{v_2}{\Phi_2} \right)^{-\theta/1+\theta} + \left(\sum_{m=3} \frac{v_m}{\Phi_m} + \frac{v_1}{\Phi_1} + \frac{v_2}{\Phi_2} x^{\theta} \right)^{-\theta/1+\theta} + A \\
\Phi_2 &= \left(\sum_{m=3} \frac{v_m}{\Phi_m} + \frac{v_1}{\Phi_1} x^{\theta} + \frac{v_2}{\Phi_2} \right)^{-\theta/1+\theta} + x^{\theta} \left(\sum_{m=3} \frac{v_m}{\Phi_m} + \frac{v_1}{\Phi_1} + \frac{v_2}{\Phi_2} x^{\theta} \right)^{-\theta/1+\theta} + A
\end{aligned}$$

where $A = \sum_{j=3} z_j^{\theta} w_j^{-\theta}$. If $v_1 = v_2$ then the solution of the system entails $\Phi_1 = \Phi_2$. Also, if $\Phi_1 = \Phi_2$ then necessarily $v_1 = v_2$. Now we show that when $v_1 > v_2$ the solution of the system is such that $\Phi_1 < \Phi_2$. We consider $(\Phi_1 - \Phi_2)'_{v_1}$ at the point $v_1 = v_2$ and $\Phi_1 = \Phi_2$. At the point $v_1 = v_2$ and $\Phi_1 = \Phi_2$ we have

$$(\Phi_1 - \Phi_2)'_{v_1} = \frac{-\theta}{1+\theta} \left(\sum_{m=3} \frac{v_m}{\Phi_m} + \frac{v_1}{\Phi_1} x^{\theta} + \frac{v_1}{\Phi_1} \right)^{-\theta/(1+\theta)-1} \frac{1}{\Phi_1} \left(x^{2\theta} + 1 - 2x^{\theta} \right) < 0$$

This establishes that a small increase in v_1 implies that $\Phi_1 < \Phi_2$. Now suppose there exist $v_1 > v_2$ such that $\Phi_1 > \Phi_2$. Due to continuity there

would exist $v_1 > v_2$ such that $\Phi_1 = \Phi_2$. But this contradicts $v_1 = v_2 \iff \Phi_1 - \Phi_2 = 0$. Thus, the solution of the system above implies that if $v_1 > v_2$, then $\Phi_1 < \Phi_2$. Thus, we have that $\Phi_1 < \Phi_2$ in equilibrium, and this implies $w_1 > w_2$.

Now consider two countries such that country 1 has HP in the first industry and country 2 has HP in the second industry. We assume that $v_1 = v_2 = v$ and (as above) that $\hat{x}_{j1} = \hat{x}_{j2} = z_j$ for any $j = 3, .., N$. We will show that $x_1 > x_2$ implies $w_1 > w_2$. From 12 we see that $w_1 > w_2$ is equivalent to $\left(x_1^\theta - 1\right)\Phi_2 > \left(x_2^\theta - 1\right)\Phi_1$. Obviously, $x_1 = x_2 \iff \Phi_1 = \Phi_2$. We can write $\Phi_1 = f(x_1, x_2)$ and $\Phi_2 = g(x_1, x_2)$. Moreover, $f(x_1, x_2) = g(x_2, x_1)$.This implies that $\left(x_1^\theta - 1\right)\Phi_2 - \left(x_2^\theta - 1\right)\Phi_1 = \left(x_1^\theta - 1\right)g(x_1, x_2) - \left(x_2^\theta - 1\right)f(x_1, x_2) = 0$ if and only if $x_1 = x_2$. We have that $\left(x_1^\theta - 1\right)\Phi_2 - \left(x_2^\theta - 1\right)\Phi_1$ is equal to

$$\sum_{j=3}^{N} z_j^\theta w_j^{-\theta/1+\theta}\left(x_1^\theta - x_2^\theta\right) + \left(x_1^\theta - 1\right)\sum_{j=1,2}\hat{x}_{j2}^\theta w_j^{-\theta/1+\theta} - \left(x_2^\theta - 1\right)\sum_{j=1,2}\hat{x}_{j1}^\theta w_j^{-\theta/1+\theta}$$

Notice that $\sum_{j=3}^{N} z_j^\theta w_j^{-\theta/1+\theta}\left(x_1^\theta - x_2^\theta\right) > 0$, as $x_1 > x_2$. Consider then

$$A \equiv \left(x_1^\theta - 1\right)\sum_{j=1,2}\hat{x}_{j2}^\theta w_j^{-\theta/1+\theta} - \left(x_2^\theta - 1\right)\sum_{j=1,2}\hat{x}_{j1}^\theta w_j^{-\theta/1+\theta}$$

Using $\hat{x}_{11}^\theta = x_1$, $\hat{x}_{21}^\theta = 1$, $\hat{x}_{12}^\theta = 1$, $\hat{x}_{22}^\theta = x_2$, and 12, and simplifying, we get

$$\begin{aligned} A &= \left(\sum_{m=3..N}\frac{v_m}{\Phi_m} + \frac{vx_1^\theta}{\Phi_1} + \frac{v}{\Phi_2}\right)^{-\theta/1+\theta}\left(2x_1^\theta - 1 - x_1^\theta x_2^\theta\right) \\ &\quad - \left(\sum_{m=3..N}\frac{v_m}{\Phi_m} + \frac{vx_2^\theta}{\Phi_2} + \frac{v}{\Phi_1}\right)^{-\theta/1+\theta}\left(-x_2^\theta x_1^\theta - 1 + 2x_2^\theta\right) \end{aligned}$$

Differentiating A w.r.t. x_1 and evaluating at $x_1 = x_2 = x$ and $\Phi_1 = \Phi_2 = \Phi$ yields

$$\begin{aligned} A'_{x_1} &= \left(\sum_{m=3..N}\frac{v_m}{\Phi_m} + \frac{vx_1^\theta}{\Phi_1} + \frac{v}{\Phi_2}\right)^{-\theta/1+\theta}\theta x_1^{\theta-1}\left(2 - x^\theta + x^\theta - \frac{\frac{\theta}{1+\theta}\left(2x^\theta - 1 - x^{2\theta}\right)\frac{v\theta x^{\theta-1}}{\Phi_1}}{\sum_{m=3..N}\frac{v_m}{\Phi_m} + \frac{vx_1^\theta}{\Phi_1} + \frac{v}{\Phi_2}}\right) \\ &= \left(\sum_{m=3..N}\frac{v_m}{\Phi_m} + \frac{vx_1^\theta}{\Phi_1} + \frac{v}{\Phi_2}\right)^{-\theta/1+\theta}\theta x_1^{\theta-1}\left(2 + \frac{\frac{\theta}{1+\theta}\left(-2x^\theta + 1 + x^{2\theta}\right)\frac{v\theta x^{\theta-1}}{\Phi_1}}{\sum_{m=3..N}\frac{v_m}{\Phi_m} + \frac{vx_1^\theta}{\Phi_1} + \frac{v}{\Phi_2}}\right) > 0 \end{aligned}$$

This implies that if $x_1 > x_2$, then $A > 0$ and, thereby, $\frac{x_1^\theta - 1}{\Phi_1} > \frac{x_2^\theta - 1}{\Phi_2}$. This implies that $w_1 > w_2$.

Now consider two industries with the same size. The only difference is the number of countries that have HP of size x in these two industries. Assume that a set J_i of countries have HP in industry $i = 1, 2$, with $J_2 \subset J_1$. We have

$$\begin{aligned}
\Phi_1 &= x^\theta w_1^{-\theta} + w_2^{-\theta} + x^\theta \sum_{j \in J_2} w_j^{-\theta} + x^\theta \sum_{j \in J_1/J_2} w_j^{-\theta} + \sum_{j \notin J_1} w_j^{-\theta} \\
&= x^\theta \left(\frac{x^\theta v}{\Phi_1} + \frac{v}{\Phi_2} + \sum_{m \geq 3} \frac{v_m}{\Phi_m} \right)^{-\theta/(1+\theta)} + \left(\frac{v}{\Phi_1} + \frac{x^\theta v}{\Phi_2} + \sum_{m \geq 3} \frac{v_m}{\Phi_m} \right)^{-\theta/(1+\theta)} \\
&\quad + x^\theta \sum_{j \in J_2} w_j^{-\theta} + x^\theta \sum_{j \in J_1/J_2} w_j^{-\theta} + \sum_{j \notin J_1} w_j^{-\theta}
\end{aligned}$$

and

$$\begin{aligned}
\Phi_2 &= w_1^{-\theta} + x^\theta w_2^{-\theta} + x^\theta \sum_{j \in J_2} w_j^{-\theta} + \sum_{j \in J_1/J_2} w_j^{-\theta} + \sum_{j \notin J_1} w_j^{-\theta} \\
&= \left(\frac{x^\theta v}{\Phi_1} + \frac{v}{\Phi_2} + \sum_{m \geq 3} \frac{v_m}{\Phi_m} \right)^{-\theta/(1+\theta)} + x^\theta \left(\frac{v}{\Phi_1} + \frac{x^\theta v}{\Phi_2} + \sum_{m \geq 3} \frac{v_m}{\Phi_m} \right)^{-\theta/(1+\theta)} \\
&\quad + x^\theta \sum_{j \in J_2} w_j^{-\theta} + \sum_{j \in J_1/J_2} w_j^{-\theta} + \sum_{j \notin J_1} w_j^{-\theta}
\end{aligned}$$

If $J_2/J_1 = \emptyset$ (which implies that $J_1 = J_2$) then $\Phi_1 = \Phi_2$. As J_2/J_1 becomes non-empty, then $\Phi_1 > \Phi_2$. But recall that since $x_1 = x_2 = x$ and $v_1 = v_2 = v$ then

$$w_1 = \left(\sum_m \frac{x^\theta v}{\Phi_1} + \frac{v}{\Phi_2} + \sum_{m \geq 3} \frac{v_m}{\Phi_m} \right)^{1/1+\theta}$$

and

$$w_2 = \left(\sum_m \frac{v}{\Phi_1} + \frac{x^\theta v}{\Phi_2} + \sum_{m \geq 3} \frac{v_m}{\Phi_m} \right)^{1/1+\theta}$$

This implies that $w_2 > w_1$.

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TABLE 1

Country	Tariff Revenues					Tariffs					Changes 1985-2004		
	1980	1985	1990	2000	2004	1980	1985	1990	2000	2004	Change Rev	Change Tariff	Change STD
India	15.5	24.2	21.1	8.4	5.7	74.3	98.8	79.2	32.5	28.1	-18.5	-70.7	-32.8
Bangladesh	13.4	17.9	12.1	7	8.2	99.9	86	102.2	21.6	16.4	-9.7	-69.6	-36.8
Paraguay	6	2.2	3.3	3.4	2.2	71	71.7	16	10.9	8.5	0	-63.2	-6.5
Pakistan	15.3	14.7	15.2	5.6	3.9	77.6	78	58.8	46.6	16.1	-10.8	-61.9	-14.8
Peru	10.6	8.3	3.9	4.5	3.4	57	64	36	13.4	9.6	-4.9	-54.4	-22.1
Nicaragua	8.7	7.4	4.3	1.8	1.3	54	54	24.8	3.2	4.9	-6.1	-49.1	.
Costa Rica	5.3	6.9	7	1.1	1.1	55	53	16.4	5.4	5.7	-5.8	-47.3	-5.4
Guatemala	4.8	7.5	3.6	2.5	2.7	50	50	23	7.2	5.1	-4.8	-44.9	-19
Brazil	10	3.2	3.7	4.2	4.2	.	55.6	30	14.4	13.1	1.0	-42.5	-10.3
Madagascar	8.5	.	14	10.2	10.3	31.5	46	36	.	5.2	.	-40.8	.
China	5.7	10	3.7	1.5	1.8	49.5	39.5	40.3	16.3	9.8	-8.2	-29.7	-22.1
Ecuador	7.2	6.2	4	5.2	5.2	.	37.7	37.1	12.9	11.5	-1	-26.2	-20.7
Senegal	11.4	8.3	11.8	8.3	9.3	.	39	35	12	13.4	1	-25.6	.
Chile	2.8	5.7	3.7	2.3	.7	10	30	15	9	4.9	-5	-25.1	0
Turkey	6.3	3	2.8	.7	.4	44	26.6	22.7	7.1	2.6	-2.6	-24	-21
Egypt	13.1	12.1	5.9	7	6	47.4	42.8	33.5	20.5	18.9	-6.1	-23.9	-386.3
Benin	10.6	.	.	.	.	.	37.4	.	12	14	.	-23.4	.
Uganda	3.1	11.6	10.8	11.4	9.8	.	30	30.1	8.3	6.7	-1.8	-23.3	.
Philippines	6.8	6.2	6.6	2.7	2.5	38	27.6	24.3	7.6	4.4	-3.7	-23.2	-1.9
Kenya	6.1	7.4	6.3	7.5	7.5	40.3	39.2	43.7	19.3	16.2	.09	-23	-8
Colombia	7.8	7.5	6	2.5	2.3	33.5	33.6	30.4	11.7	11.3	-5.2	-22.3	-2.1
Mali	3.8	5	4.6	.	.	35	35	25	12	12.8	.	-22.2	.
Zambia	2.4	6.4	4.8	7.3	7.3	.	34.8	25.6	14.7	13.2	.9	-21.6	.
Venezuela	3	9.1	2.2	3.1	1.8	.	32.9	30.6	13.5	12.2	-7.3	-20.7	-18.5
Uruguay	8.9	5.8	5.6	2	1.9	.	31	30.5	11.1	10.8	-3.9	-20.2	2.1
Sri Lanka	11.7	10.6	8.8	2.1	2.5	41.3	29	26.9	9.9	9.8	-8.1	-19.2	-16.2
Thailand	6.9	6.5	5.4	1.4	1.3	32.3	31.2	40.8	17	13.3	-5.2	-17.9	-7.2
Burundi	18.1	17	22.9	13.3	13.3	.	37.9	37	.	20	-3.7	-17.9	.
Tanzania	7.7	6.3	7.5	11.9	11.9	.	32	29.7	19.1	14.1	5.5	-17.9	.
Ghana	17.3	21.7	11.6	4.6	4.6	.	30	17.5	15.2	13.1	-17.1	-16.9	.
Argentina	9.5	12.7	9.9	3.1	7.4	27.8	27	20.5	12.6	11.4	-5.3	-15.6	-17.1
Mexico	17.6	2.6	2	1	1	30.9	30	11.1	16.2	14.6	-1.6	-15.4	2.3
South Korea	4.1	3.6	3.4	1.3	1.3	20.4	23	13.3	8.7	9.3	-2.3	-13.7	-.7
Central African Rep.	10.6	.	11.5	8.6	8.6	.	32	32	18.6	18.9	.	-13.1	.
Congo, Rep. of	3.8	.	8.2	1.1	1.6	.	32	.	17.6	19.6	.	-12.4	.
Syria	7.1	5.6	2.9	3.7	3.7	37.3	27	20.4	.	14.6	-1.9	-12.4	.
New Zealand	2.5	2	1.7	.8	1.6	13	16	14.5	3.4	3.7	-.4	-12.3	-11.3
Bolivia	7.8	7	2.3	2.4	2	.	19.8	16.7	9.5	7.5	-5	-12.3	.
Nigeria	8.5	5.1	4	.	.	32.6	37	34.3	.	24.8	.	-12.2	-15.2
Indonesia	2.9	1.6	2.4	.5	1	29	18.1	20.3	8.4	6.4	-.6	-11.7	-5.9
Mauritius	9.6	9.6	7.6	4.6	3.6	34.9	34.9	27.6	31	23.5	-6	-11.4	-63.7
Gabon	7.3	6.4	4.8	.	.	43.3	29.6	.	20.4	18.6	.	-11	.
Cote d'Ivoire	12.8	11.8	10.9	9.3	9.9	27.5	23.3	33	12	12.7	-1.9	-10.6	.
Congo, Dem. Rep.	10.3	8.4	9.1	6.4	5.5	23.6	22.4	20.7	.	13	-2.9	-9.4	.
Poland	.	8.6	6	1.2	1	.	13.6	11.7	10	4.3	-7.6	-9.3	.90
Australia	3.6	3.2	3.1	1.3	1.6	14.5	13.3	14.2	5.8	5.1	-1.6	-8.2	-7.8
Austria	.7	.6	.7	.3	.2	11.6	10	8.7	2.4	1.8	-.4	-8.2	-5.2
Nepal	8.6	7.7	8.8	5.1	6.9	22.1	22.6	22.6	14.7	14.8	-.79	-7.8	.
Jamaica	.9	1.7	.	2.2	3	16.5	17	17	10.6	9.4	1.3	-7.6	.
Trinidad &	3.2	5.7	2.7	10.2	10.2	.	17	18.6	18.4	9.7	4.5	-7.3	4.7

Tobago													
Canada	2.4	1.7	1.2	.3	.3	11.2	10.5	9.4	3.9	3.7	-1.4	-6.8	-2.1
Malaysia	7.7	5.7	3.2	1.6	.6	10.6	13.6	13	9.2	7.4	-5.1	-6.2	20.8
Italy	.4	.3	.3	.3	.2	8.8	7.5	7.4	2.4	1.8	-.1	-5.7	-2.3
Denmark	.5	.4	.3	.3	.2	8.8	7.5	7.4	2.4	1.8	-.2	-5.7	-2.3
Belgium	.3	.3	.4	.3	.2	8.8	7.5	7.4	2.4	1.8	-.1	-5.7	-2.3
Luxembourg	.1	.1	.1	.3	.2	8.8	7.5	7.4	2.4	1.8	.1	-5.7	-2.3
Netherlands	.4	.4	.5	.3	.2	8.8	7.5	7.4	2.4	1.8	-.2	-5.7	-2.3
Germany	.5	.5	.5	.3	.2	8.8	7.5	7.4	2.4	1.8	-.3	-5.7	-2.3
Ireland	3.5	3	3	.3	.2	8.8	7.5	7.4	2.4	1.8	-2.8	-5.7	-2.3
Spain	2.7	3	1.5	.3	.2	8.8	7.5	7.4	2.4	1.8	-2.8	-5.7	-2.3
France	.5	.4	.4	.3	.2	8.8	7.5	7.4	2.4	1.8	-.2	-5.7	-2.3
Greece	3.2	.7	.6	.3	.2	8.8	7.5	7.4	2.4	1.8	-.5	-5.7	-2.3
United Kingdom	.7	.6	.6	.3	.2	8.8	7.5	7.4	2.4	1.8	-.4	-5.7	-2.3
Finland	.8	.4	.6	.3	.2	10.4	7	7.7	2.4	1.8	-.2	-5.2	-5.2
Norway	.3	.3	.3	.3	.2	6.2	5.7	5.7	2.9	.5	-.1	-5.2	7.1
Guyana	1.8	3.9	.	.	.	.	17	.	17	12	.	-5	.
Belize	8.7	10.9	10.8	6.6	6.6	.	17	.	.	12.9	-4.3	-4.1	.
Malawi	6.6	8.8	5.7	8.1	8.1	.	16.7	15.2	19.6	12.9	-.6	-3.8	.
Japan	.9	.8	.9	1.5	1.5	9.5	6.7	6.9	4.5	2.9	.7	-3.8	-.8
United States	1.1	1.7	1.5	.8	.9	7.3	6.6	6.2	4	3.2	-.8	-3.4	3.4
Algeria	.	.	.	5.5	7.6	11.7	21.7	24.6	24.6	18.4	.	-3.3	.
Iran	17	14.2	5.4	3.1	4.9	20.7	20.7	20.7	4.9	17.5	-9.2	-3.2	.
Sweden	.7	.3	.4	.3	.2	7.5	4.1	4.7	2.4	1.8	-.1	-2.3	.09
Haiti	9.9	8	6.7	.	.	27.7	11.6	.	10	10	.	-1.6	.
Iceland	6.5	4.6	4	.5	.4	9.6	6.7	3.8	1.9	5.1	-4.2	-1.6	.6
Namibia	.	.	7.3	12.5	8.5	9.4	6	11	7.2	4.5	.	-1.5	-1.3
Cyprus	4	4.4	4.2	1.3	1.3	17.1	17.6	16.5	16.4	16.4	-3.1	-1.2	.
Switzerland	2.4	2	1.9	.3	.3	4.6	4.4	4.4	0	3.2	-1.7	-1.2	0
Botswana	12.8	7.1	6.6	6.1	6.1	9.4	6	11	7.2	5	-1	-1	-1.3
Papua New Guinea	3.3	5.9	7.1	7.3	6.1	.	7	7	21.1	6.4	.1	-.5	.
Kuwait	.	.	1.2	1.1	1.3	.	4	.	.	3.5	.	-.5	.
Singapore	.4	.3	.1	.1	0	.3	.3	.4	.4	0	-.3	-.3	-1.8
Hong Kong	.5	.6	.4	.3	0	0	0	0	0	0	-.6	0	0
United Arab Emirates	0	0	0	0	0	.	4	.	4	4	0	0	.
Jordan	7.1	6.1	5	4.6	3.1	.	13.8	.	24	14.4	-3	.5	-2.9
Tunisia	9	13.3	9.5	3.6	2.4	26.4	24	27.5	30.6	25.3	-10.9	1.2	2.5
Barbados	3.7	3.4	3.6	.	3.1	.	17	.	19	19	-.3	2	.
South Africa	1.2	1.4	2.2	1.5	1.6	9.4	6	11	8.5	8.5	.2	2.5	.3
Bahamas	8.1	9.3	9.6	11	11	29.8	32.3	.	35	35	1.7	2.7	.
Morocco	10.7	6.4	8.6	7.4	7.4	54	23.5	23.5	33.6	28.3	1	4.7	.
Oman	.	1.4	1	.9	.8	.	3	.	4.7	8	-.6	5	.
Zimbabwe	1.7	8	9.2	7.3	7.3	10	8.7	10.1	21.4	15.9	-.6	7.2	6.8
Romania	.	.	.4	1.6	.9	.	.	.	15.2	13.3	.	.	.
Guinea-Bissau	.	7.7	.	.	.	.	.	.	12	13.9	.	.	.
Ukraine	.	.	.	1	1.7	.	.	.	10.5	7.9	.	.	.
Sierra Leone	13.3	11.9	4	10	10	25.8	25.8	.	.	.	-1.9	.	.
Myanmar	14.2	17.6	19.4	19.8	15.2	.	.	.	.	4.4	-2.4	.	.
Rwanda	13.3	.	14.2	.	.	.	.	.	.	8.3	.	.	.
Russia	.	.	.	4.6	9.8	.	.	.	12.6	10.3	.	.	.
Czech Rep.	.	.	.	.5	.1	.	.	.	6.5	5.1	.	.	.
Niger	8.4	9.5	9.8	.	.	.	.	.	12	12.8	.	.	.
Albania	.	.	.	7.3	3.4	.	.	.	17	8.3	.	.	.
Togo	12.4	8.6	9.2	.	.	.	.	.	12	14.4	.	.	.

Fiji	5.8	7.9	6.4	4.5	4.5	.	.	.	12.4	12.4	-3.4	.	.
El Salvador	6.2	7.1	4.1	1.5	1.6	48	.	21.1	7.4	5.4	-5.5	.	.
Croatia	.	.	.	2.6	.7	.	.	.	6.7	4.1	.	.	.
Portugal	2.1	1.2	1.3	.3	.2	.	.	7.4	2.4	1.8	-1	.	-2.3
Vietnam	.	.	.	.	2.8	.	.	.	.	13.6	.	.	.
Honduras	6.7	.	.	2.9	2.9	41	.	20	7.9	5.2	.	.	.
Lithuania	.	.	.	.3	.1	.	.	.	5.4	1.2	.	.	.
Dominican Republic	9.8	6.5	6.3	7.2	6.5	.	.	28	19.5	10.3	0	.	.
Hungary	5	3.7	5.1	.8	.6	.	.	.	8.2	8.9	-3.1	.	3.7
Bahrain	.9	.7	1.1	1.3	.9	.	6	.	.	.	.2	.	.
Panama	3.1	4.1	1.8	4	1.6	.	.	40	9.5	7.9	-2.5	.	.
Israel	5.1	2.9	.9	.3	.4	.	.	.	2	4.5	-2.5	.	.
Latvia	.	.	.	.3	.2	.	.	.	5.6	3.2	.	.	.
Taiwan	3.6	2.8	2.1	1.5	.8	.	.	9.7	8.8	6.9	-2	.	.
Slovenia	.	.	.	.8	.3	.	.	.	11.8	3.9	.	.	.
Slovak Rep.	.	.	.	1	.2	.	.	.	6	22.1	.	.	.
Cameroon	11	6.1	5.4	9.2	9.2	.	.	.	18.4	18.1	3.1	.	.
Malta	4.9	4.5	4.9	.6	.7	.	.	.	8.8	8.8	-3.8	.	.
Bulgaria	.	5.4	1.3	.7	.7	.	.	11.4	13.7	10.2	-4.7	.	.

TABLE 2
CROSS-COUNTRY STUDIES ON OPENNESS AND GROWTH

Study Author and Date	Measure of Openness	Data Description	Identification Strategy	Does Openness increase Growth?
1. Tyler (1981)	1) Annual average real growth rate of total exports; 2) Manufacturing sector export earnings	Cross-sectional data for 55 middle-income developing countries from 1960-1977	No identification strategy	Significant positive impact of exports on economic growth.
2. Feder (1982)	1) Export growth* export/GDP ratio; 2) Growth rate of exports (in specific inter-sectoral externalities regression)	Pooled data from 31 semi-industrialized countries and 17 developed countries between 1964 and 1973	No identification strategy	Significant positive impacts of exports on economic growth (exported-oriented policies) bring the economy closer to an optimal allocation of resources.
3. Salvatore (1983)	Growth of percentage of exports in GDP	Pooling of cross-section and time-series data for 52 developing countries from 1961-1978	Full information maximum likelihood; uses consumer price index and index of real GDP of all market economics as instruments for exports	No significant positive impact of exports on economic growth. Trade is very important to the development process, but more in the nature of a handmaiden than as an engine of growth. The policy implication is that excessively pursuing a policy of industrialization through import substitution can retard growth.
4. Balassa (1985)	1) Export growth* share of exports in GDP; 2) Trade orientation (the deviation of actual from hypothetical value of per capita exports)	Pooled data for 43 semi-industrialized countries from 1973-1979	No identification strategy	The results show that the growth rate of GNP is higher with a greater extent of outward orientation at the beginning of the study period and the greater the extent of reliance on export promotion in response to the external shocks of the period.
5. Gupta (1985)	Growth rate of exports	Time series data for 1) South Korea from the first quarter of 1960 to the last quarter of 1979 and 2) Israel from 1967-1981.	Sims causality test	Bidirectional causality between exports and economic growth for both countries.
6. Jung & Marshall (1985)	Growth rate of real value of exports	Time series, annual data for 37 developing countries from 1951-1981	Granger causality test	Export led growth in only 5 countries while no causality in 20 countries.
7. Kavoussi (1985)	1) RX: growth of a specific country's total export earnings; 2) RW: growth of a country's export earnings due to expansion of world demand for its traditional commodities; 3) RC: a rise in the share of world markets for a country's traditional commodities; 4) RD: an increase in the share of nontraditional commodities in a country's total exports; 5) RCD: an indicator of the effect of trade policy (where RCD=(1+RC)*(1+RD)-1; values greater	Cross-sectional data for 52 low- and middle-income developing countries from 1967-1977.	No identification strategy	Firstly, the study shows that a rapid expansion of export earnings requires both favorable external markets and outward-oriented commercial policies. Secondly, the results suggest that free trade appears to enhance growth only when external demand is favorable.

	than or equal to 0 imply an outward trade orientation, while values less than 0 imply an inward trade orientation.			
8. Chow (1987)	Export growth in manufactured goods	Time series, annual data for 8 newly industrializing countries (NICs) from the 1960's and 1970's	Sims causality test	Export led growth in only Mexico, strong bidirectional causality between export growth and industrial development in other 7 countries.
9. Darrat (1987)	Growth rate of real value of exports	Time series, annual data for Hong Kong, Korea, Taiwan and Singapore from 1955-1982	White's causality test	Exports and economic growth are significantly and positively correlated. Causality runs from exports to economic growth only in Korea. For the remaining three countries, the export-led growth hypothesis is rejected.
10. Goncalves & Richtering (1987)	1) Annual average growth rate of total export volume in 1975 prices; 2) Average share of exports in GDP; 3) Change in share of exports in GDP in each period.	Pooled data for 70 developing countries from 1960-81	No identification strategy	No significant positive impact of exports on GDP net of exports.
11. Hsiao (1987)	Exports	Time series, annual data for Hong Kong, Korea, Taiwan and Singapore during the 1960's, 1970's, and 1980's	Granger & Sims causality tests	The Sims' test indicates a feedback relationship while the Granger test indicates no causal relation between the exports and GDP, except for Hong Kong where both tests indicate a unidirectional causality from GDP to exports.
12. Ram (1987)	1) Export growth rates; 2) Export growth rates* export GDP shares	Time series & cross sectional data for 88 countries from 1960-72 & 1973-82	No identification strategy	Significant positive impact of exports on economic growth.
13. Grabowski (1988)	1) Growth of exports; 2) Share of exports in GDP	Time series, annual data for Japan from the 1880's to the 1940's	Single and simultaneous equations; uses the volume of world trade and the time period as instruments for the growth of exports	The results show that growth in Japan was not export led, in the sense that external demand stimulated rapid export growth resulting in substantial economic growth. Using a simulation analysis, it was found that policies aimed at export promotion had a positive impact on economic growth.
14. Rana (1988)	1) Export growth rate; 2) Export growth rate* share of exports in GDP	Pooled data for 43 developing countries	No identification strategy	Supports the view that exports would have less effect on growth when the world environment is unfavorable

15. Singer & Gray (1988)	1) Growth of country's total export earnings; 2) Trade policy factor RCD = (1+RC)* (1+RD), where RC is the competitiveness factor and RD is the diversification factor. Positive values of RCD represent outward trade orientation.	Pooled data for52 developing countries from 1967-1973 & 1977-1983	No identification strategy	Positive impact of exports on economic growth under favorable world market conditions; however, this positive impact is weaker for low-income countries.
16. Kohli & Singh (1989)	1) Growth of exports; 2) Export share in GDP; 3) Growth of exports*share of exports in GDP	Pooled data for 30 countries from 1960-70 & 1970-81	No identification strategy	Significant positive impact of exports on economic growth in export-oriented nations. The impact is subject to diminishing returns.
17. Kunst & Marin (1989)	Manufacturing sector exports	Time series, annual data for Australia	Granger causality test	Positive causality from productivity to exports
18. Mbaku (1989)	Growth rate of exports	Pooled data for 37 African countries from 1970-81	No identification strategy	The results show that export expansion significantly enhances economic growth in Africa.
19. Koschos (1989)	Growth rate of real exports	Cross-sectional data for 71 developing countries from 1970-80	No identification strategy	The evidence contradicts the view that among "more advanced" developing economies the effect of export expansion on growth is stronger than among "less advanced" ones. In fact, among "less developed" countries output growth is mainly influenced by export expansion and capital formation, its response to labor growth being highly significant.
20. Fosu (1990)	Annual export growth	Cross sectional data for 28 Least-Developed Countries (LDCs) in Africa from 1960-70 & 1970-80	No identification strategy	Significant positive impact of exports on economic growth, but this positive relationship is smaller compared to other LDCs.
21. Grabowski, Sharma & Dhakal (1990)	Growth of exports	Time Series, annual data for Japan from 1885-1939 & 1952-1980	Granger causality test	No export led growth in pre World War II period but export led growth in post World War II.
22. Sheehey (1990)	Export growth* share of exports in GDP	Pooled data for 36 countries from 1960-1970	No identification strategy	This is a critique of Balassa and Feder's work particularly. The author argues that, since the link between sectoral growth and growth of GDP is common to all sectors, the growth clearly cannot be due to relative productivity differences and externality effects. By showing the same tests that support the ‘promotion’ of all major components of GDP, the author argues that the previous tests have no bearing at all on the export-promotion/import-substitution controversy.
23. Afxentiou & Serletis (1991)	Growth rate of real value of exports	Time series, annual data for 16 developed countries	Granger causality test	Growth led exports in 3 nations and was bidirectional in the US. In general, there is no significant causality between export growth and GNP growth in these 16 countries.

24. Ahmad & Kwan (1991)	1) Total real value of exports; 2) Total real value of manufactured exports; 3) Share of manufactured exports in total exports	Pooled time-series and cross-sectional data for 47 developing African countries from 1981-1987	Granger causality test	No support for export led growth or growth led exports.
25. Alam (1991)	1) Export growth; 2) Qualitative evaluation of trade orientation (*World Bank Development Report* 1987), including effective rates of protection, export incentives, exchange rate alignments and direct controls	Pooled data for 41 developing countries from 1965-73 & 1973-84	No identification strategy	Significant positive relationship between outward orientation and exports and output growth rates for both time periods. Moreover, the impact of trade policies on growth rates acted more strongly through increases in productivity rather than increases in investment rates.
26. Dodaro (1991)	1) Manufactured exports as a percentage of total merchandise exports; 2) dummy variable equal to one if over 50% of a country's exports are make up of fuels, minerals and metals, 0 otherwise.	Pooled data for 41 developing countries	Instrumental variable technique; uses nominal per capita GNP and population size as instruments for manufactured exports	The level of development is an important determinant of the degree of manufacturing and processing in a country's export basket. Moreover, the results show that the composition of exports affects economic growth. Concentration of exports in manufactures and greater levels of processing allow for greater diversification and a reduction in concentration both with respect to commodities and market areas. This reduction in concentration may reduce export earnings instability, fostering further economic growth.
27. Esfahani (1991)	1) Share of imports in GDP* growth rate of imports; 2) Share of exports in GDP * growth rate of exports	Cross-sectional data for 31 semi-industrialized countries from 1960-73, 1973-81 & 1980-86	Simultaneous equations; uses log GDP per capital and log labor as instruments for export and import variables	Export promotion is particularly important for countries that cannot obtain sufficient foreign aid or capital.
28. Kwan & Cotsomotis (1990)	Ratio of exports to national income (the growth rate of exports to national income is used as a robustness check)	Time series, annual data for China from 1952-85	Granger causality test	Bidirectional causality between exports and economic growth for the post-reform period (since 1978), but no causality for the pre-reform period.
29. Oskooee, Mohtadi & Shabsigh (1991)	Export growth	Time series, annual data for 20 least-developed countries (LDCs) from the 1950's to the 1980's	Granger causality test with Akaike's optimal lag criterion	The study indicates positive causality from economic growth to export growth in 4 out of 20 countries (Korea, Nigeria, South Africa and Thailand) and negative causality in Indonesia. Korea and Thailand exhibit positive causality in both directions.
30. Salvatore & Hatcher (1991)	Growth rate of real value of exports	Time series & pooled, annual data for 26 developing countries from 1963-73 & 1973-85	No identification strategy	The econometric results only partially support the hypothesis that international trade benefits most developing countries and that an outward orientation leads to a more efficient use of resources and growth.
31. Sharma, Norris & Cheung (1991)	Export growth	Time series, quarterly data for 5 industrialized countries from 1960-1987	Granger causality test	Export led growth for Germany and Japan, while growth led exports for the US and the UK. There was no causality in either direction for Italy.

32. Dollar (1992)	1) Dollar measure of outward orientation: RPLi= 100*ePi/Pu.s.,where RPLi is the index of country i's relative price level, e is the exchange rate, and Pi is the consumption price index for country i; 2) Variability of the real exchange rate	Cross-sectional data for 95 countries from 1976-85	No identification strategy	Significant negative relationship between distortion in the real exchange rate and growth of per capita GDP after controlling for the effects of real exchange rate variability and investment level. Trade liberalization, devaluation of the real exchange rate and maintenance of a stable real exchange rate could improve growth performance in poor countries.
33. Edwards (1992)	1) Index of trade intervention; 2) INVERV1, overall intervention index obtained when a homoskedastic (unscaled) model is used to predict trade flows for the 183 commodities in the sample; 3) INVERV2, overall intervention index obtained when a heteroskedastic (scaled) model with residuals proportional to GNP is used; 4) OPEN1, overall openness index obtained from the unscaled trade model; 5) OPEN2, overall openness index obtained from the residuals of the scaled trade model; 6) OPENM1, manufacturing sector openness index obtained from the unscaled trade model; 7)OPENM2, manufacturing sector openness index obtained from the scaled heteroskedastic trade model	Cross-sectional data for 30 developing countries from 1970-82	Instrumental variable technique; uses the average and coefficient of variation of the black market premium to identify the level of trade restrictions	A strong positive relationship exists between trade orientation and economic performance. The relationship is robust to the method of estimation, to correction for errors in variables and to the deletion of outliers.
34. Egwaikhide (1992)	1) Natural log of real value of oil exports; 2) Natural log of real value of oil imports	Time series, annual data for Nigeria from 1973-78	Instrumental variable technique; uses the natural logs of the lags of real imports and the price for crude oil as instruments for real exports	Crude oil exports have only marginally stimulated the growth of output in Nigeria.
35. Giles, Giles & McCann (1992)	Real value of exports	Time series, annual data for New Zealand from 1963-1991	Granger causality test	The study finds mixed evidence for the export-led growth hypothesis when they use growth rates of exports and output. While they reject the hypothesis at the aggregate level, there is some support for the ELG of certain exporting sectors (such as minerals, chemicals, plastics, metal, metal products, live animals, and meat). However, replacing levels of exports and output with growth rates, there is causality from real exports of manufactured goods, meat, and live animals to real GDP.
36. Hutchison & Singh (1992)	Growth rate of real value of exports	Time series, annual data for 34 developing countries from the 1950's to the 1980's	Granger causality test	11 countries showed evidence of significantly positive export externality effects contributing to non-export sector domestic growth. Three countries showed evidence of externalities in the non-export sector contributing to export growth and three countries showed evidence of negative externalities.

37. Levine & Renelt (1992)	1) Exports as a percentage of GDP; 2) Imports as a percentage of GDP; 3) Leamer's (1988) openness measure based on factor-adjusted trade; 4) Leamer's(1988) trade-distortion measure based on H-O deviations; 5) Black-market exchange-rate premium; 6) Dollar's (1992) real exchange-rate distortion for SH benchmark countries.	Pooled data for 119 countries from 1960-1989	No identification strategy	Significant positive correlation between share of investment in GDP and share of trade in GDP. None of the measures of openness are robustly correlated with growth when other explanatory variables are introduced.
38. Marin (1992)	Log of exports of manufacturing goods (quarterly observations)	Time series data for the US, UK, Japan and Germany	Granger causality test	Exports cause labor productivity in all the countries studied. The hypothesis of export-led growth cannot be rejected.
39. Serletis (1992)	1) Log of exports; 2) Log of imports	Time series, annual data for Canada from 1870-1985	Granger causality test	Causality from exports to growth but no causality from imports to growth.
40. Sheehey (1992)	1) Share of exports in GDP; 2) Growth rate of share of exports in GDP; 3) Average annual growth rate of exports.	Pooled data for 53 non oil exporting and 6 developed countries from 1960-81	No identification strategy	Significant positive impact of exports only during favorable world demand & in industrialized countries.
41. Wilbur & Haque (1992)	Natural log of exports	Time series, annual data for 11 developing and 6 developed countries from 1960-72 & 1973-87	No identification strategy	Supports the "export expansion" hypothesis, emphasizing the significant importance of exports in the formation of savings for both highly developed and less developed countries.
42. Alege (1993)	1) Real value of total exports; 2) Real value of oil exports	Time series, annual data for Nigeria from covering the period of 1960-85	Granger causality test	The results show the existence of strict econometric exogeneity between exports and GDP and a unidirectional causality from GDP to oil exports. No causality from total export growth (or oil export growth) to GDP growth.
43. Dodaro (1993)	Manufactured exports as a percentage of total merchandise exports	Time series, annual data for a wide range of least-developed countries (LDCs)	Granger causality test	The causality test shows very little support for the basic export promotion contention. There are two main results of this study: first, the level of development is an important determinant of the degree of manufacturing and processing in a country's export basket; second, the efficiency of export-led growth depends on the composition of exports and the stage of development.
44. Ghartey(1993)	Log of exports	Time series, seasonally adjusted quarterly data for Taiwan, Japan and the US	Stepwise Granger causality test (Hsiao's version of Granger causality test)	Exports cause economic growth in Taiwan; economic growth causes exports in the US; and there is bidirectional causality in Japan.
45. Gordon & Sakyi-Bekoe (1993)	Real value of exports	Time series, annual data for Ghana from 1955-87	Granger causality test, Sims model, modified Sims model, Akaike final prediction (error model) and the non-parametric multiple rank F-test model	Causality results vary depending upon the model used for testing and the lag specification defined. The violation of the normality assumption leads the Granger model to the apparently incorrect conclusion that GDP causes exports.

46. Khan & Saqib (1993)	Natural log of real value of total exports, manufactured exports and primary exports	Time series, annual data for Pakistan from 1972-1988	Simultaneous equations; uses foreign income and the index of domestic export prices to world export prices to identify the export demand function, and uses the effective exchange rate index and the relative price index to identify the export supply function	A strong positive association between export performance and economic growth is found, but more than 90 percent of the contribution of exports to economic growth is indirect in nature.
47. Oskooee & Asle (1993)	Real value of exports	Time series, quarterly data for 9 LCDs	Granger causality tests with the new techniques of cointegration and error-correction models	The results indicate bidirectional causality for all countries (except for Malaysia for which there is no cointegration) between export growth and economic growth when the cointegrating properties of the time series are incorporated into the analysis.
48. Oxley (1993)	Natural log of real value of exports	Time series, annual data for Portugal from 1833-1985	Granger causality test	The export-led growth hypothesis is rejected in favor of reverse causality.
49. Sengupta (1993)	1) Export growth; 2) Export growth*share of exports in GDP	Time series, annual data, mainly focused on newly-industrialized countries (NICs) in Asia including Japan, the Philippines, South Korea, and Taiwan, from the 1960s to the 1980s	No identification strategy	The empirical evidence supports the basic premises of the new growth theory in the case of the successful NICs in Asia and for Korea, in particular.
50. Atesoglu (1994)	Growth rate of real value of exports	Time series, annual data for the US from the 1960's to the 1980's	Instrumental variables technique; uses the rate of growth of external prices and the rate of growth of the world's real income to instrument for exports	The export-led Kaldor growth model interprets and predicts the short-run fluctuation in the growth rate of the US economy. Moreover, the dynamic Harrod foreign trade multiplier rule of Thirlwall is not preferable to the Kaldorian model for explaining annual changes in the US rate of growth.
51. Coppin (1994)	1) Real exports; 2) Growth rate of real exports; 3) Share of manufactured exports in total exports; 4) Share of the growth rate of manufactured exports in total exports	Pooled data for 59 low- and middle-income countries during the 1980's	No identification strategy	Positive impact of exports (but not manufactured exports) on economic growth. The results also show that the growth in the labor force was an important factor in explaining growth.
52. Dutt & Ghosh (1994)	Real value of exports	Time series, annual data for 26 low-, middle- and high-income countries from 1953-91	No identification strategy	For the majority of the countries in the sample, export growth and economic growth have moved together.
53. Greenaway & Sapsford (1994a)	Growth rate of share of exports in GDP	Cross-sectional data for 104 countries from 1960-88	No identification strategy	The results support the hypothesis that exports and growth are positively correlated. This relationship is robust to variations in the composition of the country samples. Moreover, the strength of the association varies from sub-period to sub-period, but the positive association becomes stronger over time. Export growth does not always follow reform.

54. Greenaway & Sapsford (1994b)	Growth rate of share of exports in GDP	Time series, annual data for 5 developing countries from 1956-88	No identification strategy	Significant positive impact of exports on economic growth for Sri Lanka, but negative for Turkey.
55. Hansen (1994)	1) Growth rate of exports * percentage of exports in GDP; 2) Growth rate of exports of manufactured goods and services* percentage of manufacturing and service exports in GDP; 3) Growth rate of 'other' commodity exports * percentage of 'other' commodity exports in GDP	Time series, annual data for New Zealand from 1968-1991	Engle-Granger cointegration test	Exports of manufactures and services have had a greater effect on the economy's recent growth experience than exports of primary products and raw materials.
56. Hotchkiss, Moore & Rockel (1994)	1) Annualized growth rate of exports weighted by the proportion of exports in GNP; 2) Annualized growth rate of exports (unweighted)	Annual data for 85 countries from 1960-1986	No identification strategy	The results indicate that exports contribute to growth through both a sector-externality effect and a factor-productivity effect for middle income countries, but only through a factor-productivity effect for low income countries.
57. Love (1994)	Export growth	Time series, annual data for 20 developing countries from the 1960's to the 1990's	Granger causality test	Substantial support for the hypothesis that exports cause growth. In 14 out of 20 countries there is evidence of causality from export growth to GDP growth, with causality being positive for 10 countries and negative for 4.The export-led results are highly sensitive to the definition of economic growth.
58. Sengupta & Espana (1994)	1) Time derivative of exports; 2) Average share of exports in GDP; 3) Real export growth	Time series, annual data for Japan, the Philippines, Taiwan, Thailand and South Korea from the 1960's to the 1980's	Engle-Granger cointegration test	The externality effect of exports and their productivity growth played the role of a catalyst for other sectors' growth. Exports and output are cointegrated and there is evidence of a significant positive impact of exports on economic growth, particularly in South Korea.
59. Sharma & Dhakal (1994)	Growth rate of real value of exports	Time series, annual data for 30 developing countries from 1960-88	Granger causality test	Causal relationship between export growth and output growth is found in five countries; export-led growth is found in six; output growth causes export growth in eight; no causal relationship for remaining countries. No causal relationship between export and output growth for South Korea.
60. Ukpolo (1994)	Annual percentage growth rates of exports of fuel products	Time series, annual data for 8 low-income African countries from 1969-88	No identification strategy	Significant positive impact of non-fuel primary exports on economy.
61. Yaghmaian (1994)	1) Exports in constant prices; 2) Average annual growth rate of exports	Pooled and time series data for 66 developing countries from 1971-1980 & 1981-1990	No identification strategy	A positive and statistically significant association was obtained between export growth and the growth of output when population statistics were used for the labor variable in the neoclassical growth model. However, when substituting employment for population, there was no statistical support for export-led growth.

62. Ahmad & Harnhirun (1995)	Real exports evaluated in per capita terms in 1980 prices	Time series, annual data for 5 Asian countries from 1966-90	Granger causality test with error correction model	Causality between exports and economic growth in both directions for Singapore.
63. Amirkhalkhaili & Dar (1995)	Growth rate of real value of exports	Time series, annual data for 23 developing countries from the 1960's to the 1990's	No identification strategy	There is evidence of export-led growth for all except the strongly inward-oriented group of countries. No major difference between moderately inward-oriented countries and moderately- and strongly outward-oriented countries in terms of the impact of export expansion on economic growth.
64. Clark (1995)	1) Qualitative evaluation of trade orientation (*World Bank Development Report* 1987), including effective rates of protection, export incentives, exchange rate alignments and direct controls; 2) Real export growth	Time series and pooled, annual data for 35 developing countries from 1973-1985	No identification strategy	Significant positive impact of exports and outwardly-oriented trade policy on industrial diffusion rather on output growth.
65. Coe & Helpman (1995)	(Ratio of imports of goods and services to GDP) * (Natural log of foreign R & D capital stock)	Pooled data for 21 OECD countries and Israel from 1971-1990	No identification strategy	Demonstrates the extent to which a country's total factor productivity depends not only on domestic R&D capital but also on foreign R & D. Foreign R & D has beneficial effects on domestic productivity and the result is stronger when the country is more open to foreign trade.
66. Holman & Graves (1995)	First difference of log of exports	Time series, annual data for South Korea from 1953-1990	Granger and Sims causality tests	The Sims results found consistent two-way exogeneity between exports and GNP growth. The Granger causality results indicate that there is bidirectional causality between exports and economic growth.
67. Jin (1995)	1) Natural log of real value of goods exported; 2) Natural log of world commodity price level for all exports (used as a proxy for foreign price shocks); 3) Natural log of industrial production index for all industrial countries (used as a proxy for foreign output shocks)	Time series, seasonally adjusted quarterly data for Hong Kong, Singapore, South Korea and Taiwan from 1973-1993	Granger causality tests	The results from the variance decompositions indicate significant feedback relations between exports and output for Hong Kong, Singapore and South Korea, which can be interpreted to suggest that in the short-run, economic growth and export growth reinforce each other. However, the Granger cointegration test suggests that no long-run equilibrium exists between exports and the level of output.
68. Jin & Yu (1995)	Exports of goods and services	Time series, seasonally adjusted quarterly data for Korea, Japan, Canada and the US	Granger causality test	The results do not support the causal implication of the export-led growth hypothesis. For Korea and Japan, there is bidirectional causality between export growth and GNP growth; for Canada and US, growth led exports.
69. Kwan & Kwok (1995)	Export growth	Time series, annual data for China from 1952-1985	Granger causality test	Exports led growth including instantaneous causality.

70. Lee (1995)	1) Ratio of imported to domestic capital goods; 2) Ratio of imports to investment; 3) Share of imports in GDP	Cross-sectional data for 79 countries from 1960-85	Instrumental variable technique; uses land size, distance from trade distortion as instruments for openness measures	The ratio of imported to domestically produced capital goods in the composition of investment has a significant positive impact on per capita income growth rates across countries, and for developing countries in particular. Moreover, the ratio of foreign to domestic components of investment is an important factor in economic growth. The policy implication is that any trade distortions that restrict the importance of capital goods hurt the economy in the long run.
71. McCarville & Nnadozie (1995)	Real value of exports	Time series, annual data for Mexico from 1926-88	Granger causality test	Supports the export-led growth argument.
72. Paul & Chowdhury (1995)	Natural log of growth rate of real exports	Time series, annual data for Australia from 1949-91	Granger causality test	There is evidence of Granger causality running from exports to GDP growth, implying that expansion of exports promotes economic growth in Australia.
73. Rashid (1995)	Growth of the real value of exports	Time series, annual data for India from 1960-1989	2SLS, 4 equation multivariate simultaneous model; uses RER and LW to instrument for the growth rate of exports. Note: RER is the nominal exchange rate times producer prices in the US divided by India's consumer price index (CPI) as a percentage change; LW is world income.	The results support that idea that trade is the handmaiden of growth and suggest that domestic factors play a more important role in increasing growth rates. Furthermore, the study shows that liberalization has not had a significant effect on industrialization and investment in the study period.
74. Abhayaratne (1996)	Logs of real exports and imports (measured in 1985 prices)	Time series, annual data for Sri Lanka from 1960-92	Granger causality test	The results reject the notion that foreign trade stimulates economic growth.
75. Amoateng & Amoako-Adu (1996)	Growth rate of real value of exports	Pooled (including time series and cross-sectional data) data for 35 African countries from 1970-90	Granger causality test (trivariate model, introducing external debt servicing as a third variable)	Both the export-driven GDP growth and GDP growth-led export promotion hypotheses are supported. During the 1983-90 sub-period, the structural adjustment programs that removed some of the economic distortions and encouraged regular repayment of the external debt also improved economic outcomes in the countries studied.
76. Bodman (1996)	Logs of manufacturing goods exports	Time series, seasonally adjusted quarterly data for Australia and Canada from 1960-95	No identification strategy	Export-led growth hypothesis holds for both economies. The reverse causality is rejected for both countries, except for the Canadian manufacturing sector, for which there is a small, significant positive effect of labor productivity on manufactured exports.
77. Boltho (1996)	Export growth	Time series, annual data for Japan from 1913-1937, 1952-1973, & 1973-90	Granger causality test (in both directions)	For the period 1952-73, not one of the five tests supports the idea of export-led growth. For the remaining two periods, the export-led growth hypothesis seems to be rejected.

78. Burney (1996)	Export growth	Cross–sectional data from 1965-80 & 1980-90, which consists of 89 and 95 countries respectively.	No identification strategy	The study confirms that there is a positive relationship between exports and economic growth. However, the relationship is significant only for the period 1980-90. Moreover, the level of significance of the impact of exports on economic growth is relatively higher for high income economies.
79. Cheng & Chu (1996)	Natural log of exports in constant dollars	Time series, annual data for the US from 1940-90	Granger causality test	The results show bidirectional causality between exports and economic growth.
80. Doraisami (1996)	Growth rate of real values of exports	Time series, annual data for Malaysia from 1963-1993	Engle-Granger causality test	The study provides strong empirical support for bidirectional causality between exports and output and a positive long-run relationship between exports and growth.
81. Dutt & Ghosh (1996)	Real value of exports	Time series, annual data for 26 developed and developing countries	Engle-Granger cointegration & causality tests with error-correction model	The study provides evidence of cointegration in only 14 countries. It shows that export causes growth in five countries, while growth causes exports in two countries. Bidirectional causality is found in three countries, and no causality is found in four countries.
82. Fosu (1996)	1) Growth rate of real exports; 2) Mean annual growth rate of non-fuel primary exports; 3) Average annual non-fuel primary exports as a percentage of total exports	Pooled, time series and cross-sectional data for 76 less developed countries from 1967-1986	No identification strategy	The study shows that exports have a positive effect on GDP growth. Moreover, this positive impact generally remains positive when non-export GDP is the dependent variable. Lastly, the growth of non-fuel primary exports exhibits little or no external impact on the non-export sector (casting some doubt on the sustainability of primary product export-led growth).
83. Harrison (1996)	1) Trade reform (1960-84); 2) Trade reform (1979-88); 3) Black market premium; 4) Price distortion; 5) Trade shares; 6) Unprotected agriculture; 7) Movement towards international prices	Pooled, time series and cross-sectional data for developing countries	Granger causality test	Significant positive impact of openness on economic growth. The Granger causality test shows that causality between exports and growth runs in both directions. However, the choice of time period for analysis is critical.
84. Henriques & Sadorsky (1996)	Natural log of real value of exports	Time series, annual data for Canada from 1870-1991	Granger causality test	The results tend to favor the one-way Granger causal relationship that the growth rate of GDP influences export growth.
85. Jin & Yu (1996)	Real value of exports	Time series, quarterly data for the US from 1959-1992	No identification strategy	Based on the VAR techniques, no significant causal impacts are found between exports and output. This suggests that export expansion is neutral with respect to the growth of the US economy.
86. Karunaratne (1996)	Growth rate of value of exports	Time series, seasonally adjusted quarterly data from Australia from 1979-1994	Granger causality test with error correction	Trade operated as an engine of growth in Australia during the study period.

87. Kwan, Cosotmitis & Kwok (1996)	Growth rate of real value of exports	Time series, annual data for Taiwan from 1953-1988	No identification strategy	The result shows that while the weak exogeneity assumption appears to be valid, the super exogeneity assumption is rejected. Thus, the results cast doubt on policy recommendations based on the export-led growth hypothesis.
88. Mallick (1996)	Growth rate of real value of exports	Time series, annual data for India from 1950-1992	Engle-Granger causality tests with error correction model	Cointegration and causality test results indicate the existence of strong cointegration and Granger causality between income and exports growth. Causality runs from income to export growth.
89. Mollik (1996)	Growth rate of real value of exports	Time Series, annual data for Bangladesh from 1972-1992	Granger & Sims causality tests	Exports cause economic growth but not the opposite.
90. Mulaga & Weiss (1996)	Growth rate of effective protection (ERP): ERPi=(ti-aij*tj)/(1-aij) where ti and tj are the the tariffs or tariff-equivalents for goods i and j, respectively, and aij is the share of input j in the value of output i at world prices.	Firm level data for Malawi from 1970-1991	No identification strategy	The impact of a decline in protection on total factor productivity depends upon the way productivity growth is measured. The study finds a positive relationship for the simple TFP estimates. However, the growth seems unassociated with changes in protection when capital input is measured by capital services rather than capital stock.
91. Piazolo (1996)	1) Real value of exports of goods and services; 2) Real value of imports of goods and services; 3) Trade orientation dummy variable (import substitution dummy variable is 0 from 1965-82; export diversification dummy variable is 1 from 1983-92)	Time series, annual data for Indonesia from 1965-1992	Engle-Granger causality test	Indonesian long-run economic growth is more investment–driven than trade- or export driven. However, the short-run terms effects of exports are strongly positive.
92. Pomponio (1996)	Manufactured goods exports	Time series, annual data for 66 developing and OECD countries from 1960-1988	Granger causality test	The bivariate causality tests show weak evidence supporting the idea that manufactured exports lead to output growth. However, when the investment factor is included in the trivariate causality test, there is mixed evidence in support of the trivariate causal relationships.
93. Riezman, Whiteman & Summers (1996)	1) Growth rate of exports; 2) Growth rate of imports; 3) Share of exports + imports in GDP	Time series, annual data for 126 countries from 1960-85	Granger causality test	30 out of 126 countries support the export-led growth hypothesis; 25 out of 126 countries support the growth-led exports hypothesis. Using a weaker notion of "support", 65 out of 126 countries support the export-led growth hypothesis. For the "Asian Tiger" countries, the relationship between export growth and output growth becomes clearer when conditioned on human capital and investment growth as well as import growth.
94. Thornton (1996)	Natural log of real value of exports	Time series, annual data for Mexico from 1895-1992	Granger causality test	Positive Granger causal relationship running from exports to economic growth.

95. Al-Youslf (1997)	1) Growth rate of value of exports; 2) Growth rate of exports*share of exports in GDP	Time series, annual data for Saudi Arabia, Kuwait, UAE and Oman from 1973-1993	No identification strategy	Significant positive impact of exports on economic growth. However, economic growth is highly affected by oil.
96. Berg (1997)	1) Growth rate of real value of exports (in Granger causality test); 2) Growth rates of real values of exports and imports (in simultaneous equations)	Time series data for Mexico from 1960-1991	Granger causality test; Simultaneous equations; uses the real exchange rate and the growth rate of real GDP of the US to instrument for exports; uses the real exchange rate and a measure of foreign capital inflows to instrument for imports	During the period 1960-1991, trade and real output growth were positively related in Mexico. Simultaneous equation regressions suggest that both exports and imports significantly explain the growth of total factor productivity in Mexico. However, this study also points out the limitations of empirical exercises due to the changing composition of exports and shifting policy regimes, and emphasizes the importance of theoretical work.
97. Coe, Helpman & Hoffmaister (1997)	1) Change of the share of machinery and equipment imports from industrial countries in GDP in each developing country (denoted by M); 2) M* log of foreign R&D capital stock	Pooled data for 77 developing countries and 22 industrialized countries from 1971-1990	No identification strategy	The results imply that a developing country's total factor productivity is larger the larger is its foreign R&D capital stock, the more open it is to machinery and equipment imports from industrial countries and the more educated is its labor force.
98. Gani (1997)	Growth rate of the (real) share of exports in GDP	Time series, annual data for Papua New Guinea from 1970-1992	No identification strategy	Exports and stable exchange rates have positively contributed to economic growth.
99. Ghatak, Milner & Utkulu (1997)	1) Natural log of the real value of exports (in Granger causality test); 2) Real value of exports of manufactured goods, fuel and non-fuel primary products (in Johansen maximum likelihood procedure)	Time series, annual data for Malaysia from 1955-1990	Granger causality test	The results provide support for the export-led growth hypothesis; aggregate exports Granger-cause real GDP and non-export GDP. This relationship is found to be driven by manufactured exports rather than by traditional exports.
100. Gokkceus (1997)	Natural log of the industry-specific annual total protection rate, including all charges on imports such as customs duty, municipality tax, stamps, funds, etc.	Panel data with annual observations for 29 four-digit rubber industry plants in Turkey from 1983-1986	No identification strategy	This study reveals that trade liberalization or declining protection have a significant positive effect on productivity growth.
101. Greenaway, Morgan & Wright (1997)	1) Growth in real value of merchandise exports; 2) Percentage change in exports	Pooled data for 74 developing countries from the 1980's to the 1990's	No identification strategy	In general, liberalization seems to have been associated with deterioration in growth for this sample; the result was robust for both the full and the restricted samples.
102. Liu, Song & Romilly (1997)	Natural logs of exports and imports	Time series, quarterly data for China from 1983-1995	Granger causality test	Bidirectional causality between economic growth and exports plus imports, which is consistent with China's development strategy of protected export-promotion.

103. Park & Prime (1997)	1) Growth rate of exports; 2) Share of exports in GDP; 3) Growth rate of exports * share of exports in GDP	Pooled and cross-sectional data for 26 inland provinces and 11 coastal provinces in China	No identification strategy	The results support the hypothesis that exports have contributed to the growth of provincial incomes in China for the period examined with both the cross-sectional and pooled analyses, with the results being primarily driven by the comparison between the coastal provinces and the inland areas.
104. Pineres & Ferrantino (1997)	1) GEXP, the growth rate of the real value of exports; 2) RXR, the real exchange rate; 3) TRAD7 is the variance of the traditional index calculated across industries; 4) Specl, a static measure of specialization; 5) CSX, a measure of the change in export composition	Time series, annual data for Chile from 1962-1992	Granger causality test	In general, growth periods in Chile have been associated with stability in the composition of exports and an acceleration of export diversification. There is a positive relationship between export diversification and economic growth.
105. Begum & Shamsuddin (1998)	1) Level of exports; 2) Share of exports in GDP; 3) Growth rate of exports; 4) Export growth rate weighted by the share of exports in GDP. Note: OLS results use the last measure as the exports variable	Time series, annual data for Bangladesh from 1961-1992	Instrumental variable technique; uses the annual growth rate of world income and the difference between foreign and domestic inflation rates to instrument for exports	Export growth has significantly increased economic growth through its positive impact on total factor productivity in the economy. The contribution of exports to economic growth was more pronounced during 1982-90, when the government pursued a policy of trade liberalization and structural reform and political turmoil was not persistent.
106. Biswal and Dhawan (1998)	Natural log of total real value of exports and total real value of manufactured goods exports	Time series, annual data for Taiwan from 1960-1990	Granger causality test with error correction model	The study finds evidence of bidirectional causality between exports and growth.
107. Clerides, Lach & Tybout (1998)	A dummy variable that equals 1 if the plant exports, 0 otherwise.	Plant-level, panel data for Columbia (1981-1991), Morocco (1984-1990) and Mexico (1984-1990)	1) Full information maximum likelihood (FIML); simultaneously estimates export market participation patterns and marginal cost realizations; 2) GMM; used to test the robustness of the marginal cost estimate	The study addresses the question of whether the association between exporting and efficiency reflects causation flowing from exporting experience to improvements in performance. The actual data suggest an inconsistent causality pattern (no-learning-by-exporting scenario). The FIML and GMM tests confirm that the association between exporting and efficiency is most plausibly explained as low-cost producers choosing to become exporters.
108. Doyle (1998)	Natural log of the real value of exports	Time series, annual data for Ireland from 1953-1993	Granger causality test with error correction	Exports and GDP are cointegrated. Evidence of short-run and long-run causality runs from exports to growth.
109. Iscan (1998)	Share of exports in GDP	Panel, sector-level data for Mexico from 1970-1990	Granger causality test with VAR model	The study found no evidence that exports lead to capital accumulation or vice versa. However, there is evidence that common determinants, such as the real exchange rate, may be the driving force for the capital accumulation.

110. Islam (1998)	Value of exports	Time series data for 15 Asian countries from 1967-1991	Multivariate error-correction model to test the Granger causality between exports and growth	Causality test results indicate that export expansion causes growth in two-third of these countries, corrected for simultaneity between the causal factors. A country with a large public sector, higher level of economic development, and lower vulnerability to external economic shocks, is more likely to reap the benefits of export promotion strategies.
111. Keller (1998)	A foreign knowledge stock variable which is a weighted sum of the cumulative R&D expenditures of a country's trading partners (the weights are given by the bilateral import shares)	Panel data for 21 OECD countries from 1971-1990	Monte-Carlo based robustness test; R&D spillovers among randomly matched trade partners investigated	Randomly matched trade patterns give rise to greater positive R&D spillovers than do true bilateral trade patterns, suggesting that the Coe and Helpman (1995) model of trade-related international R & D spillovers is not robust.
112. McNab & Moore (1998)	Dummy variables for inwardly-oriented trade policy and outwardly-oriented trade policy	Pooled data for 41 countries	Simultaneous estimations; openness measures are used as instruments	Outward trade policy increased annual GDP, and trade policy is a robust determinant of growth.
113. Onafowora & Owoye (1998)	Real value of exports and trade policy dummies	Data from 12 sub-Saharan African (SSA) countries from 1963-1993	Johansen's conintegration tests and VECM	Changes in trade policies and exports have positive effects on growth for 10 out of 12 SSA countries.
114. Shan & Sun (1998a)	Growth rate of real value of exports	Quarterly, seasonally adjusted data for Australia from 1978-1996	Granger causality test using Toda and Yamamoto method	Results indicate one-way causality from industrial growth to export growth with a one-year lag.
115. Shan and Sun (1998b)	Natural log of exports	Monthly, seasonally adjusted data for China from 1978-1996	Granger causality test using Toda and Yamamoto method	Results indicate bidirectional causality between exports and real industrial output in China.
116. Shan & Sun (1998c)	1) Natural log of the growth rate of exports; 2) Natural log of the growth rate of imports.	Quarterly, seasonally adjusted data for Hong Kong, South Korea and Taiwan from 1978-1996	Granger causality test using Toda and Yamamoto method, followed by sensitivity analysis	Principal results from the paper cannot offer support for the export-led growth hypothesis. Hong Kong and Korea show bidirectional Granger causality between exports and growth.
117. Pineres & Ferrantino (1999)	1) Natural log of real value of exports; 2) the mean of a cumulative export experience function for each commodity (traditionality scores); 3) a static measure of specialization which approaches 1 implying a high degree of specialization and nears 0 suggesting a degree of export diversification.	Annual data for Columbia from 1962-1993	1) Cointegration and error-correction modeling used to test relationship between GDP and exports; 2) simultaneous equation system: using the price of coffee, oil, lagged log of real exports, world interest rates as instruments for openness measures.	Traditional Granger causality tests reveal little evidence of export-led growth. However, analysis of structural export change and export diversification sheds significant light on the trade–growth linkages. Results reveal a positive interaction between structural changes in the export sector and Colombian GDP growth .Results indicate that increased export diversification leads to more rapid growth in real exports; and that more rapid structural change in exports is associated with accelerated growth in Colombian GDP.
118. Clark, Sawyer & Sprinkle (1999)	Trade policy orientation, measured using Dollar's index of real exchange rate distortion	Pooled data for 94 developing countries	No identification strategy	Outward-oriented trade strategies are found to have an important effect on industrialization.

119. Dhawan & Biswal (1999)	1) Natural log of real value of exports; 2) Terms of trade	Annual data for India from 1961-1993	VAR model; Johansen test for cointegration; Engle and Granger's error correction approach (to determine the direction of causal flow in the short-run as well as in the long-run)	The results suggest that there is one long-run equilibrium relationship among real GDP, real exports and terms of trade, and the causal relationship flows from GDP growth and terms of trade to export growth. The causality from exports to GDP appears to be a short-run phenomenon.
120. Frankel & Romer (1999)	Trade is measured using instrumental variables that take account of countries' geographic locations	Cross-sectional data for 150 countries	OLS and instrumental variables techniques	Trade has a positive effect on income growth.
121. Greenaway, Morgan & Wright (1999)	1) Real value of exports; 2) Eecomposition of exports into different categories	Panel data for 69 countries from 1975-1993	No identification strategy	Results report a strong positive relationship between real export growth and real output growth. The study also finds that export composition does matter.
122. Moosa (1999)	Sum of exports of goods and services	Annual data for Australia from 1900-1993	Cointegration and causality tests	Results fail to detect either a long-run or short-run relationship between exports and growth.
123. Vamvakidis (1999)	1) Share of exports plus imports in GDP; 2) Economy judged "open" if it meets five conditions from Sachs and Warner: a) average tariff less than 40 percent; b) average nontariff barriers less than 40 percent; c) black market premium less than 20 percent of official exchange rate; d) government is not communist; f) no state monopoly on major exports.	Data covers the period from 1950 to 1992. Data for real GDP per capita, investment share, and population growth are from the Penn World Table; trade shares come from the World Table (World Bank, 1994), and school enrollment ratio are from Barro and Lee (1994). The analysis focuses on 109 countries engaged in regional trade agreements (RTA) and 51 countries engaged in broad liberalization between1958-1989.	No identification strategy	Economies grow faster after broad liberalization, in both the short-run and the long–run; however, they grow more slowly after an RTA.
124. Weinhold & Rauch (1999)	Share of exports plus imports in GDP	Data from 39 countries 1960-1990	No identification strategy	Increased trade may lead to growth.
125. Xu & Wang (1999)	Foreign R&D spillovers weighted by total imports, capital goods imports, and non-capital goods imports	Data from 21 OECD countries from 1983-1990	No identification strategy	Trade in capital goods was found to be a significant channel of R&D spillovers.
126. Anoruo & Ahmad (1999)	Growth rate of the share exports plus imports in GDP	Time series, annual data for Indonesia, Malaysia, the Philippines, and Thailand from 1960-1997	Granger causality test	The results show bidirectional causality between economic growth and openness.

127. Al-Marhubi (2000)	1) Average share of exports in GDP from 1961-88; 2) Export structure, measured as the ratio of manufactured good exports to total exports from the World Development Indicators 1997	Cross-sectional data for 91 countries from 1961-1988	No identification strategy	The results show that export diversification is associated with faster growth. This relationship is economically large and is robust to different model specifications and different measures of export diversification. Moreover, distortions to international trade and market-oriented resource allocation that run counter to a country's comparative advantage can have adverse effects on economic efficiency and growth performance.
128. Anwer & Sampath (2000)	Natural logs of goods and non-factor service exports	Time series, annual data for 97 countries from 1960-1992	Granger causality test	In 97 countries, GDP and exports are integrated of different orders for 36 countries. Among the other 61 countries, 17 countries exhibit no long-run relationship between the two variables; 35 countries show causality in at least one direction (10 countries show unidirectional causality from GDP to exports, 5 show unidirectional causality from exports to GDP, and 20 show bidirectional causality), and 9 countries do not show any causality.
129. Choudhri & Hakura (2000)	Sector openness index, which depends on how international trade affects the technology transfer process	Panel data for 44 countries (including 33 developing countries) from 1970-1993	No identification strategy	The effect of increased openness on productivity growth differs across sectors. In traditional (low-growth) manufacturing sectors, no effect or little effect exists; for medium-growth sectors, import competition has a significant growth-enhancing effect; and there is some evidence to show that export expansion in high-growth sectors leads to an increase in productivity growth.
130. Darrat, Hsu & Zhong (2000)	Real value of exports	Data for Taiwan from 1953-1988	VECM model after Johansen cointegration tests, instead of simple Engel-Granger procedure	The exports are both weakly and super-exogenous to output.
131. Erlat (2000)	Export and import flows, divide into three categories: net exporting, import competing, non-competing	Annual data for Turkey from 1963-1994, divided into four sub-periods	No identification strategy	First, trade plays a more significant role in employment changes during the post-1980 periods; this is observed more in the net exporting and non-competing categories rather than the import competing category. Second, the switch to export-oriented growth in 1980 did not lead export-based employment to be dominant in employment changes, but has acted as a buffer in the sense that employment may either have grown much less or declined more severely if the post-1980 expansion of exports had not occurred.
132. Jin (2000)	Share of imports in GDP	Annual data for Japan, South Korea, Japan, the Philippines, Thailand, Malaysia and Singapore from 1955 to 1995	VAR model	The results do not strongly support the idea that openness leads to growth.

133. Kim (2000)	Direct policy measures such as legal rates of tariff, quota ratios, and nominal rates of protection	Panel data for 36 Korean manufacturing industries over nine sub-periods from 1966-1988	No identification strategy	Total factor productivity estimates based on the standard assumption of perfect competition and constant returns are biased and show a spurious relationship with changes in trade regimes. When both imperfect competition and non-constant returns are taken into account, the growth accounting approach yields estimates of total factor productivity growth that are quite low.
134. Morley & Perdikis (2000)	Growth rate of exports	Annual data for Egypt from 1955-1996	VECM and Granger causality tests	There appears no evidence of either direction of causality between exports and growth.
135. Moreira & Najberg (2000)	Value of exports and imports	National accounts series for Brazil from 1990-1997	No identification strategy	Trade liberalization has a negative short-run impact on employment , in long run, overweighed by a more labor-intensive output mix
136. Pereira & Xu (2000)	Growth rate of exports	Data for 39 countries from 1960–92	Multivariate VAR approach test to Granger relations	Results strongly support the theory of export-led growth.
137. Francisco & Ramos (2001)	Real value of exports and imports	Annual data for Portugal from 1865-1998	Granger causality in the ECM-VAR	The empirical results reject unidirectional causality between exports, imports, and economic growth. However, there are feedback effects between exports, output growth and import growth.
138. Ghirmay, Grabowski & Sharma (2001)	Real value of exports	Time series data for 19 least developed countries (each with at least 30 annual observations)	Granger causality tests based on error-correction modeling	Export expansion leads to economic growth in 15 out of 19 countries by either increasing the volume of investment, improving efficiency, or both.
139. Khalafalla & Webb (2001)	Real value of exports and imports (export data are broken down into two additional series: total value of primary commodity exports, and total value manufacturing exports).	Quarterly data for Malaysia from 1965-1996	VAR model, VECM, Granger causality test	Statistical tests confirm export-led growth for the full period and for the period to 1980, but tests on the 1981-1996 period show growth causing exports. Primary exports have a stronger direct impact on economic growth than manufactures.
140. Madden, Savage & Bloxham (2001)	Share of imports in GDP* foreign R&D capital stock	Panel data for 15 OECD countries and 6 Asian countries from 1980-1995	No identification strategy	Total factor productivity and domestic R&D are positively related. Domestic R&D has relatively large impact on total factor productivity.
141. Abdulnasser (2002)	Value of exports	Quarterly data for Japan from 1966-1999	Granger causality test in VAR model, LR test for causality and bootstrap simulation technique	There is bidirectional causality between export and output growth in Japan.
142. Chuang (2002)	A set of trade-induced learning variables that take into account trade partners and learning characteristics.	Cross-country panel data for 78 countries from 1960-1985	Panel regression. The general problem of causality is relatively minor in this study as only traded goods in a subset are taken.	Holding other variables constant, trade-induced learning has a positive and significant effect on growth.
143. Greenaway, Morgan & Wright (2002)	1) A dummy variable, equal to 1 if it is activated at the time of a country's first World Bank Structural Adjustment Loans (SALs) 2) a dummy variable based on tariffs, quotas, export impediments and	Panel data for 73 countries from 1975-1993	No identification strategy	Liberalization may favorably impact growth of real GDP per capita. However, the effect would appear to be lagged and relatively modest.

	promoters and exchange rate misalignment; 3) a dummy variable for whether an economy is open or closed based on five criteria from Sachs and Warner: non-tariff barrier coverage; average tariffs; the black-market exchange rate premium; whether the economy is socialist or not; whether a state monopoly exists over major exports.			
144. Jin (2002)	Real value of exports	Monthly data for Korea's four largest provinces (Seoul, Kyunggee, Kyungnam, and Pusan) from 1987-1996	Engle and Granger tests for cointegration, Granger causality tests, four-variable VAR model, variance decompositions and impulse responses	Export growth has a significant impact on output growth for all provinces, although a feedback effect from output to export growth appears in Seoul and the Kyungnam province.
145. Ahmed (2003)	1) Share of exports in GDP; 2) Average tariff collection rate	Times series data for Bangladesh from 1974-1996	VECM model after cointegration tests	Exports and average tariff collection rates are significant in explaining GDP growth.
146. Connolly (2003)	Sum of high technology imports and non-high technology imports, which are measured as total imports from the world, excluding high technology goods imported from developed countries.	Annual panel data for 86 countries from 1965 to 1995 (data are not available for all countries in all years)	No identification strategy	High technology imports positively affect domestic imitation and innovation. Moreover, their role is greater in developing nations. Finally, foreign technology embodied in imports plays a greater role in growth than domestic technology.
147. Dar & Amirahalkhali (2003)	1) Real value of exports; 2) Share of exports plus imports in GDP	Data for 19 countries from 1971–1999	No identification strategy	Results generally indicate that trade openness is important for economic growth, but the magnitude of the relationship varies significantly across countries.
148. Ferreira & Rossi (2003)	1) Effective rate of protection; 2) Nominal tariff	Annual data for 16 industrial sectors in Brazil from 1985-1997	Panel regression includes IV (the measurement of effective rate of protection and mess nominal tariff), 2SLS FE, and FE, no causality tests used.	There is significant evidence that reducing trade barriers improves total factor productivity and labor productivity.
149. Singh (2003)	Share of real exports in real GDP for each industry	Panel data for ten manufacturing industries in India from 1973/74-1993/94.	No identification strategy	Exports do not induce convergence, but instead seem to accentuate the process of divergence among industries. The study provides some evidence for the significant effects of exports on the level of output per capita and total factor productivity in the manufacturing sector. The effects of exports on total factor productivity are significant in half of the sample industries, but are statistically insignificant in the remaining half.

150. Yanikkaya (2003)	1) Trade volumes (import penetration; export share in GDP; trade with OECD countries; trade with non-OECD countries; US bilateral exports; US bilateral imports and population density), 2) Trade restrictions (import duties, export duties, taxes on international trade, bilateral payment arrangements and other measures of trade barriers).	Panel data for over 100 developed and developing countries from 1970-1997	Cross-country regression, including OLS, SUR, 3SLS; instrumental variables technique, using log of average GDP per capita for the previous 5 years, 5-year lagged value of life expectancy, actual value of telephone mainlines, the access to international water, war deaths, tropical climate and political regime as instruments for trade measures	The regression results for trade volumes provide substantial support for the hypothesis that trade promotes growth through a number of channels such as technology transfer, scale economies, and comparative advantage. Interestingly, all measures of trade barriers used in the study are significantly and positively correlated with growth except for restrictions on current account payments, which are negatively but insignificantly correlated with growth. Thus, the results provide considerable evidence for the hypothesis that restrictions on trade can promote growth, particularly for developing countries and under certain conditions.
151. An & Iyigun (2004)	Skill-intensive exports	Panel data for 86 countries from 1970-1990	Panel regression, followed by robustness tests including dropping outliers, causality test for direction of relationship between rate of per-capita GDP growth and subsequent skill content of exports	After controlling for GDP per capita, education, openness to foreign trade, and political and macroeconomic stability, a higher export content of skill-intensive goods generates higher per-capita GDP growth rates, but the reverse does not hold.
152. Balaguer & Cantavella, Jorda (2004)	1) Real value of exports; 2) Export composition (in relative terms), calculated as share of consumption goods, semi-manufactured and capital goods in total exports.	Annual data for Spain from 1961-2000	Johansen's cointegration test followed by Granger causality tests	Exports and growth are cointegrated, and there is bidirectional causality between exports and growth.
153. Bugsten et al. (2004)	A dummy variable, equal to 1 if a firm exports more than a certain amount (depending on company size, labor productivity, capital productivity, etc.), 0 otherwise.	Firm–level, panel data for the manufacturing sectors of four African countries: Kenya (1992-1994); Ghana (1991-1993); Zimbabwe (1992-1994); Cameroon (1992/93-1994/95).	Simultaneous estimation of a dynamic production function and a dynamic discrete choice model for the decision to export	The study finds that exporting increases productivity.
154. Chuang & Hsu (2004)	1) Natural log of share of exports to OECD in total industry sales; 2) Natural log of share of imports in total industry sales	Firm-level data for China from 1995	No identification strategy	The presence of foreign ownership has a positive and significant effect on the productivity of domestic firms. Moreover, trading with more advanced countries helps China gain access to new technology and information, which improves China's productivity and enables it to compete in international markets.
155. Dawson & Hubbard (2004)	1) Growth rate of exports; 2) growth rate of exports times the share of exports in GDP	Annual panel data for 14 Central and East European countries CEEC's from 1994-1999	First stage, aggregate production into export production and non-export production; in the second stage, random effects and fixed effects model applied to test relationship between GDP growth and export production variants.	Export growth is a significant determinant of GDP growth.

156. Dritsakis (2004)	1) Investment, measured as gross fixed capital adjusted by the GDP deflator; 2) Real export revenue	Quarterly data for Bulgaria and Romania from 1991–2001	Johansen cointegration test and Granger causality test based on a vector error correction model	There is significant evidence to show cointegration between exports and growth, as well as investment and growth. Exports promote growth in both countries; , growth also promotes exports in both countries. Investment leads to growth in both countries.
157. Dutta & Ahmed (2004)	1) Real value of exports; 2) Import tariff collection rate	Time series data for Pakistan from 1973-1995	VAR model to test long run effects, VECM model to test short run effects, both with human capital included in the model framework	There is a unique long-run relationship between industrial growth and its major determinants including real exports. The short-run relationship between industrial growth and real exports is also significant.
158. Dodzin &Vamvakidis (2004)	Share of exports plus imports in GDP	Panel data for 92 developing countries from 1960–2000	Granger causality test	The impact of trade liberalization on different sectors of production in developing economies shows increases in the production share of the industrial sector, at the expense of agricultural production.
159. Falvey, Foster & Greenway (2004)	Trade-mediated knowledge spillovers (export spillovers and import spillovers)	Data for 21 OECD countries from 1975–1990	Griliches' (1979) perpetual inventory method, weighted by imports or exports	Results support the existence of spillovers through imports, but the evidence of spillovers through exports is less compelling.
160. Lee, Ricci, & Rigobon (2004)	1) The share of trade in GDP; 2) tariff; 3) import duties; and 4) black market premium..	A panel data of eight periods of 5 years each, is spanning from 1961-1965 and 1996-2000, including 100 countries.	"Identification through Heteroskedasticity" (IH): exploit plausible differences in variances of structural innovations (error terms) across subsamples of the data	The results suggest that openness has a small positive effect on growth, which is not particularly robust.
161. Thangavelu & Rajaguru (2004)	Value of exports and imports	Time series data for Hong Kong, India, Indonesia, Japan, Malaysia, Philippines, Singapore, Taiwan and Thailand from 1960-1996	VECM approach	The long-run result shows that there is no causal effect of exports on labor productivity growth for Hong Kong, Indonesia, Japan, Taiwan and Thailand, thereby suggesting that there is no export-led productivity growth in these countries. However, significant causal effects were found from imports to productivity growth, suggesting import-led productivity growth in India, Indonesia, Malaysia, the Philippines, Singapore and Taiwan. In addition, the results indicate that imports tend to have greater positive impacts on productivity growth in the long run.

162. Awokuse (2005a)	Real value of exports	Quarterly time series data from 1963-2001 for Korea	VECM approach and augmented levels VAR modeling with integrated and cointegrated processes (of arbitrary orders) used to test Granger causality	There is bidirectional causality between exports and GDP growth.
163. Awokuse (2005b)	Real value of exports	Quarterly time series data from 1960-1991 for Japan	Augmented VAR methodology used to test Granger causality; Direct acyclic graphs (DAG) used to further restrict VAR	The causal path between exports and GDP growth in Japan is bidirectional; other variables such as capital and foreign output are also significant determinants of productivity growth in Japan.
164. Biesbroeck (2005)	Value of exports	Panel survey data for approximately 200 manufacturing firms in each of nine African countries from 1992-1996	1) GMM; uses lagged exports to test unidirectional causality from exports to productivity improvement; 2) Instrument variables technique; uses ethnicity of the owner and the state ownership	
165. Fu (2005)	Value of exports	1) Panel data of 26 manufacturing industries for the period 1990–1997 for China; 2) Pooled data for 358 sub-industries, including 179 state-owned enterprises (SOE) industries and 179 comparable township and village enterprises (TVE) industries from 1995	Uses a two stage process. First stage uses a non-parametric Malmquist TFP approach to decompose TFP growth into technical change and efficiency improvements. Second stage uses regressions to test the impact of exports on TFP growth.	No significant evidence was found in favor of significant productivity gains caused by exports at the industry level.
166. Dollar & Kraay (2002)	1) Trade volumes; 2) Tariffs; 3) Membership in the World Bank; 4) Presence of capital controls	Cross-sectional data for 92 countries and spanning the 1960's to the 1990's	No identification strategy	The study tests whether openness has systematic effects on the share of income accruing to the poorest in society. It finds little evidence to support such systematic effects, even when allowing the effects of openness to depend on the level of development and differences in factor endowments.
167. Dollar & Kraay (2004)	1) Decade-over-decade changes in the volume of trade; 2) Reductions in average tariff rates; 3) Share of trade in GDP	Cross-sectional data for 101 countries and covering periods from the 1970s to the 1990s	Instrumental variables technique; uses lagged trade volumes as instruments for current trade volumes	Changes in growth rates are highly correlated with changes in trade volumes, controlling for lagged growth and addressing a variety of econometric difficulties. However, there is no significant correlation between changes in inequality and changes in trade volumes, controlling for changes in average incomes.
168. Wacziarg & Welch (2003)	Composite measure of openness including exchange rate reforms.			Positive relationship between a composite measure of economic reforms and economic growth, but not significant for the 1990's.
169. Alcala & Ciccone (2004)	The natural log of the share of the sum of imports and exports in purchasing power parity GDP (real openness)	Cross-sectional data from Penn World Tables for 1985	IV using a geography-based instrument for trade (obtained from aggregating bilateral trade shares predicted by the gravity	Trade is a significant and robust determinant of aggregate productivity when real openness is used.

			equation). This method was first used by Frankel and Romer (1999).	
170. Rigobon & Rodrik (2004)	Log of the share of trade in GDP	Cross-sectional dataset from Penn World Tables and World Development Indicator, including 86 countries	"Identification through Heteroskedasticity" (IH): exploit plausible differences in variances of structural innovations (error terms) across subsamples of the data	The share of trade in GDP has a negative impact on income levels and democracy, but a positive impact on the rule of law.
172. Chang, Kaltani, & Loayza (2005)	Share of real exports plus real imports in real GDP	Pooled cross-country and time-series data for 82 countries from 1960-2000	Non-linear growth regression specification that interacts a proxy of trade openness with proxies of educational investment, financial depth, inflation stabilization, public infrastructure, governance, labor-market flexibility, ease of firm entry, and ease of firm exit.	The growth effects of openness are positive and economically significant if certain complementary reforms are undertaken.
173. Hausmann, Hwang, and Rodrik (2005)	A measure of the income level of a country's exports, which also captures the level of sophistication of those exports.	There are two sources of data. 1) The first is the United Nations Commodity Trade Statistics Database (COMTRADE) covering over 5,000 products at the Harmonized System 6-digit level for the years 1992-2003 (available for 124 countries over 1999-2001); 2) the real per capita GDP data from the World Development Indicators (WDI), which is available for 113 countries.	Instrumental variables technique; uses log population and log land area as instruments for the export sophistication measure	Export sophistication positively affects growth.
174. Freund and Bolaky (2008)	The log of the share of the sum of imports and exports in GDP.	Cross-country data from 126 countries covering periods from 2000 to 2004	IV using a geography-based instrument (followed by Frankel and Romer (1999)) and also using remoteness from other markets as an additional instrument for trade,	Openness interacts with regulation and only positively affects growth in unregulated economies with minimal restrictions on entry.
175. Romalis (2007)	Share of trade (evaluated at either current or constant price) in GDP	Data for developing countries from 1961-2000	Instrumental variables technique; uses US MFN tariffs as instruments for developing country trade shares	Openness positively affects per-capita GDP growth.
176. Estevadeordal and Taylor (2008)	tariffs on consumption, capital, and intermediate goods from primary sources	Data on growth rate comes from the Penn World Table database (version 6.2); data on average tariff comes from the Economic Freedom in the World 2005 database, which are available every 5 years from 1970 to 2000, plus annually for 2001, 2002, and 2003, and the sample size grows from 77 countries in 1970 to 122 in the year 2000.	IV using two "GATT Potential" instruments (the interaction of an indicator of GATT membership in 1975 with the pre-Uruguay Round tariff level and the interaction of Great Depression intensity with the initial period tariff level) to identify for trade liberalization (reflected by tariff policy)	The results show that liberalizing tariffs on imported capital and intermediate goods did lead to faster GDP growth, but that there is no relationship between consumption goods tariffs on growth..

Table 3: All Countries

Correlation between Different Openness Measures

	Exchange Rate	Trade Taxes/ Trade Volumes (PWT 6.1)	Tariffs	Openness (X + M/GDP)	Real Openness	DFI/GDP
Trade Taxes/ Trade	0.0452 283	1.0000 919				
Tariffs	-0.0314 274	0.6271* 666	1.0000 716			
Openness	-0.0172 291	-0.2459* 561	-0.2470* 464	1.0000 607		
Real Open	-0.0662 293	-0.2200* 579	-0.2970* 461	0.8921* 566	1.0000 630	
DFI/ GDP	-0.0066 281	-0.2501* 559	-0.3016* 445	0.3708* 567	0.4129* 576	1.0000 607

Notes: Data from World Bank. Time period includes 1970 through 2004. A"*" indicates significant at the 5 percent level. Number of observations are underneath correlation coefficient.

Table 4: Developing Countries Only

Correlation between Different Openness Measures

	Exchange Rate	Trade Taxes/ Trade Volumes (PWT 6.1)	Tariffs	Openness (X + M/GDP)	Real Openness	DFI/GDP
Trade taxes/ Trade	-0.0194 188	1.0000 435				
Tariffs	-0.1051 180	0.5863* 301	1.0000 323			
Openness (X+M)/GDP	0.0153 196	-0.3594* 392	-0.3556* 313	1.0000 432		
Real Openness	-0.0625 200	-0.2370* 423	-0.3473* 315	0.8379* 419	1.0000 470	
DFI/GDP |	0.0377 196	-0.2465* 406	-0.3291* 311	0.4568* 415	0.3685* 439	1.0000 450

Notes: Data from World Bank. Time period includes 1970 through 2004. A"*" indicates significant at the 5 percent level. Number of observations are underneath correlation coefficient.

Table 5: Incomes, trade shares, and import tariffs in a panel of non-OECD countries

Using Trade Shares as a Measure of Openness, 1960-2000

Dependent variable: ln income per capita, in PPP $1993

	(1) OLS No controls	(2) OLS No controls	(3) OLS Includes controls	(4) OLS Includes controls	(5) IV No controls	(6) IV No controls	(7) IV Includes controls	(8) IV Includes controls
3-year lag trade share	0.907	0.514	0.214	0.203				
	[0.036]***	[0.037]***	[0.038]***	[0.035]***				
Trade share					0.978	0.857	0.426	0.402
					[0.037]***	[0.057]***	[0.067]***	[0.064]***
Country fixed effects?	NO	YES	YES	YES	NO	YES	YES	YES
Time fixed effects	NO	NO	YES	YES	NO	NO	YES	YES
Observations	3294	3294	1996	2657	3288	3288	1996	2657

Using Import Tariffs as a Measure of Openness, 1970-2000

3-year lag Import tariff	-3.586	-0.721	-0.298	-0.137				
	[0.377]***	[0.142]***	[0.117]**	[0.119]				
Average import tariff					-4.830	-4.830	-0.635	-0.338
					[0.441]***	[0.441]***	[0.328]*	[0.379]
Country fixed effects?	NO	YES	YES	YES	NO	YES	YES	YES
Time fixed effects	NO	NO	YES	YES	NO	NO	YES	YES
Observations	1617	1617	1261	1485	1415	1415	1125	1306

Notes: Source is Aisbett, Harrison, and Zwane (2005), as reported in Harrison (2007). Huber robust standard errors in parenthesis. Data are annual data, with one observation for each country and year. The dependent variable is the log of income per capita, in PPP $1993. Trade share is the share of exports plus imports in GDP. Import tariffs are import revenues divided by the value of imports. Both are taken from the World Bank's indicators. OLS indicates ordinary least squares and IV indicates instrumental variables. All regressions exclude OECD high-income countries. Columns (3) and (7) include controls for inflation, government expenditure in GDP, currency crises, investment in GDP, and the fraction of the population that is literate. Columns (4) and (8) include controls for inflation, government expenditure, and currency crises. In instrumental variable regressions, trade share is instrumented using three-year lagged value, and import tariff is instrumented using three-year lagged value.

Table 6 (from Alfaro and Charlton (2008))

Industry	Code	Targeted by # Countries	Growth in Value Added	FDI/Value Added	Share of Value Added	Dep. External Finance	White High Skill	Blue and White High Skill
Agriculture and Fishing	1	4	2.617	0.001	0.055	-0.297	0.040	0.707
Mining of Metals	2	2	3.309	0.000	0.015	0.455	0.168	0.687
Extraction of Petrochemicals	3	5	1.473	0.009	0.012	0.318	0.341	0.674
Food Products	4	5	5.314	0.013	0.041	-1.717	0.074	0.427
Textile and Wood Activities	5	5	3.362	0.015	0.026	-0.946	0.145	0.594
Petroleum, Chemical, Rubber, Plastic Products	6	9	5.755	0.033	0.043	0.285	0.397	0.546
Metal and Mechanical Products	7	3	5.104	0.024	0.037	-0.796	0.181	0.615
Machinery, Computers, RTV, Communication	8	10	5.821	0.013	0.051	-0.692	0.352	0.619
Vehicles and Other Transport Equipments	9	11	5.999	0.032	0.022	-0.664	0.357	0.644
Electricity, Gas and Water	10	3	4.471	0.004	0.038	-0.359	0.257	0.599
Construction	11	0	6.563	0.001	0.087	-0.919	0.071	0.711
Trade and Repairs	12	1	6.004	0.010	0.163	-0.416	0.151	0.262
Hotels and Restaurants	13	5	7.518	0.003	0.031	-0.100	0.062	0.349
Land, Sea and Air Transport	14	1	5.733	0.002	0.071	-0.150	0.055	0.140
Telecommunications	15	12	6.762	0.007	0.031	-0.119	0.033	0.190
Monetary Intermediation	16	1	5.071	0.030	0.053	-2.445	0.820	0.827
Other Financial Intermediation	17	1	9.184	0.050	0.006	-3.613	0.714	0.737
Insurance	18	1	5.974	0.050	0.013	-3.586	0.761	0.773
Real Estate and Business Activities	19	11	8.741	0.008	0.210	-0.173	0.564	0.612

Notes: Number of industries corresponds to the 3 digit ISIC Rev. 3. FDI corresponds to Foreign Direct Investment Flows from OECD International Direct Investment Database. Dependence on external finance is the difference between investment and cash generated from operations in the U.S. following Rajan and Zingales (1998). Skill data is the ratio of high skilled workers to other workers in German Industries. Skilled workers include: White-collar high-skill (WCHS): Legislators, senior officials and managers (Group 1), Professionals (Group 2), Technicians and associate professionals (Group 3). White-collar low-skill (WCLS): Clerks, service workers (Group 4), shop & sales workers (Group 5). Blue-collar high-skill (BCHS): Skilled agricultural and fishery workers (Group 6), Craft & related trade workers (Group 7). Blue-collar low-skill (BCLS): Plant & machine operators and assemblers (Group 8), Elementary occupations (Group 9). See Appendix A for detailed explanation of all variables and sources.

Table 7: Foreign Investment and Technology Spillovers					
	Country	Years	Data	Technology Spillovers?	Details
1.Globerman, Steven (1979)	Canada	1972	Industry level	Yes (positive horizontal spillovers)	Positive horizontal spillovers.
2.Blomstrom, Magnus & Persson Hakan (1983)	Mexico	1970	Industry level (the Mexican manufacturing industry 1970)	Yes (positive horizontal spillovers)	Positive horizontal spillovers (the existence of spillovers efficiency benefits from the foreign-owned plants to the domestically-owned ones).
3.Blomstrom, Magnus (1986)	Mexico	Mexican census of manufactures 1970 &1975	Industry level	Yes (positive horizontal spillovers)	Positive horizontal spillovers (a result of the fact that input market start to operate better because of foreign entry rather than technology transfer).
4.Haddad, Mona & Harrison, Ann (1993)	Morocco	1985-1989	Firm level	No	No evidence of spillovers (The results reject the hypothesis that foreign presence accelerated productivity growth in domestic firms).
5.Blomstrom, Magnus & Edward N.Wolff (1994)	Mexico	1970/1975	Industry level	Yes (positive horizontal spillovers)	Positive horizontal spillovers (suggested by the fact that productivity levels of locally-owned firms in Mexico have converged on those of foreign-owned firms).
6.Caves, Richard E. (1994)	Australia and Canada	Canada (1965-67) & Australia (1963-63, 1966-67)	Industry level	Yes (positive horizontal spillovers)	Positive horizontal spillovers for both Canada and Australia (foreign investment impels higher technical efficiency in competing domestic firms and speeds the transfer of new technology of them). However, this result is not that significant for Canada probably because of the existence of tariffs.
7.Kokko, Ari (1994)	Mexico	1970	Industry level (the Mexican manufacturing industry 1970)	Large technology and high foreign shares are harmful for spillovers.	The results suggest that advanced MNC technologies or large technology gaps alone do not constitute unsurmountable obstacles to spillovers, but that spillovers are less likely in industries when large technology gaps and high foreign shares coincide.

8.Kokko, Ari (1996)	Mexico	1970	Industry level (the Mexican manufacturing industry 1970)	This paper examines the signs of productivity spillovers	This paper examines if there are signs of productivity spillovers from competition between local firms and foreign affiliates. The results indicate that spillovers from competition are not determined by foreign presence alone, but rather by the simultaneous interactions between foreign and local firms.
9.Kokko, Ari; Ruben Tansini & Mario C. Zejan (1996)	Uruguay	1988-1990	Firm level	No	No spillovers in a general sense. But there is a positive horizontal spillovers in the sub-sample of plants with moderate technology gaps vis-à-vis foreign firms.
10.Borensztein, E., J. De Gregorio, & J-W Lee (1998)	69 LDC	1970-89	Industry level (cross section)	Yes (positive horizontal spillovers)	Positive horizontal spillovers from FDI only when a sufficient absorptive capability of the advanced technologies is available in the host economy.
11.Aitken, Brian J. & Ann E. Harrison (1999)	Venezuela	1976-1989	Firm level (panel)	No	No evidence supports the existence of technology "spillovers" from foreign firms to domestically owned firms.
12.Blomstrom, Magnus & Fredrik Sjoholm (1999)	Indonesia	1991	Plant level (Indonesian Central Bureau of Statistics)	Yes (positive horizontal spillovers)	Positive horizontal spillovers (Labor productivity is higher in establishments with foreign equity than in purely domestically owned firms and the latter benefit from spillovers from FDI). But this spillovers were restricted to non-exporting local firms.
13.Chuang, Yih-Chyi & Chi-Mei Lin (1999)	Taiwan	1991	Firm level (Taiwan's manufacturing census data)	Yes (positive horizontal spillovers)	Positive horizontal spillovers effect on firm's productivity.
14.Sjoholm Fredrik (1999)	Indonesia	1980 & 1991	Plant level	Yes (positive horizontal spillovers)	Positive horizontal spillovers (suggested by the fact that high competition to increase the degree of spillovers from FDI) & high technology gaps give rise to large spillovers.
15.Sjoholm Fredrik (1999)	Indonesia	1980 & 1991	Plant level	Yes (both postitive horizontal and vertical)	Both inter-industry and intra-industry spillovers are found, which indicates an evidence of positive horizontal as well as vertical spillovers.
16.Djankov, Simeon & Bernard Hoekman (2000)	Czech Republic	1992-1996	Firm level	Yes (positive horizontal spillovers)	Positive horizontal spillovers (foreign investment has the predicted positive impact on TFP growth of recipient firms. FDI appears to have a greater impact on TFP growth than do joint ventures, suggesting that parent firms are transferring more knowledge to affiliates than joint venture firms obtain from their partners).

17.Kathuria, Vinish (2000)	India	1976-1989	Firm level	No (negative horizontal spillovers)	There is an efficiency gain for foreign-owned in 13 out of 26 sectors. For these 13 sectors, there is a negative horizontal spillover from the presence of foreign firms in the sector, but foreign technical capital stock has a positive impact.
18.Liu Xiaming; Panela Siler, Chengqi Wang & Yingqi Wei (2000)	UK	1991-1995	Industry level	Yes (positive horizontal spillovers)	Positive horizontal spillovers. The study also shows that the extent to which local firms benefit from the introduction of advanced technology depends largely on their own technological capabilities.
19.Bosco, Maria Giovanna (2001)	Hungary	1993-1997	Firm level	Insufficient evidence	The evidence for technological spillovers is weak and does not allow clear-cut conclusions. Foreign presence in high-tech industries does seems to have a positive effect on both local and foreign firms.
20.Damijan, Joze P.; Boris Majcen, Mark Knell & Matija Rojec (2001)	Bulgaria, Czech Republic, Estonia, Hungary, Poland, Romania, Slovakia Republic, Slovenia	1994-1998	Firm level	No	There are no significant positive horizontal spillovers for domestic firms from FDI. (Note: trade is an important alternative source of international R&D spillovers to firms without foreign participation in the Czech Republic, Poland, Romania and Slovenia).
21.Driffield, Nigel (2001)	UK	1989-1992	Industry level (Report on the census of production)	No	No evidence of investment or output spillovers occurring as a result of inward investment. However, catching up does occur in foreign-owned sector.
22.Girma, Sourafel; David Greeway & Katharine Wakelin (2001)	UK	1991-1996	Firm level	No	No aggregate evidence of horizontal (intra-industry) spillovers. Specifically, no wage and productivity spillovers to domestic firms as a result of foreign presence.
23.Kinoshita, Yuko (2001)	Czech Republic	1995-1998	Firm level	Yes (positive horizontal spillovers)	First, technology spillovers from FDI occur for firms that are more R&D intensive; second, spillovers from foreign joint ventures are insignificant for Czech manufacturing firms; lastly, the extent of technology spillovers is greater in oligopolistic sectors than in non-oligopolistic sectors.
24.Kokko, Ari; Mario C. Zejan & Ruben Tansini (2001)	Uruguay	1988	Firm level	Yes (positive horizontal spillovers)	Positive horizontal spillovers from FDI to a sub-sample of locally-owned manufacturing plants with moderate technology gaps vis-à-vis foreign firms
25.Konings, Jozef (2001)	Bulgaria, Romania and Poland	1993-1997	Firm level	Yes (negative horizontal spillovers) for Gulgaria and Romaina, No for Poland	On average, there are negative horizontal spillovers to domestic firms in Bulgaria and Romania and there is no evidence of spillovers in Poland (a negative competition effect that dominates a positive technology effect).

26.Kugler, Maurice (2001)	Colombia	1974-1998	Industry level	Yes (positive vertical spillovers)	This study distinguishes intra- and inter-industry spillovers. He finds widespread evidence for positive vertical (inter-industry) spillovers, while horizontal spillovers appear only to be important in machinery equipment sector.
27.Li, Xiaoying, Xiaming Liu and David Parker (2001)	China	1995 (1995 industrial census)	Industry level	Yes (positive horizontal spillovers)	Positive horizontal spillovers for state-owned enterprises. Collective-and-private-owned enterprises benefit from demonstration and contagion effects form foreign presence.
28.Barrios, Salvador & Eric Strobl (2002)	Spain	1990-1998	Firm level	Yes (positive horizontal spillovers)	Positive horizontal spillovers only when domestic firms had the appropriate "absorptive capacity".
29.Castellani, Davide & Antonello Zanfei (2002)	France, Italy, Spain	1992-1997	Firm level	Yes (positive horizontal spillovers)	Positive and significant horizontal productivity spillovers for Italian firms, negative spillovers on Spanish firms and non-significant effects on French firms.
30.Carkovic, M. & Ross Levine (2002)	72 countries	1960-1995	Industry level (cross section)	No	No evidence of spillovers.
31.Dimelis, Sophia & Helen Louri (2002)	Greece	1997	Firm level	Yes (positive horizontal spillovers)	Positive horizontal spillovers. Moreover, the spillovers stemming form minority-owned foreign establishments are larger than those from majority-owned ones.
32.Haskel, Jonathan E., Sonia C. Pereira & Matthew J. Slaughter (2002)	UK	1973-1992	Plant level	Yes (positive horizontal spillovers)	Positive horizontal spillovers from inward FDI to domestic plants.
33. Girma, Sourafel (2002)	UK	1989-1999	Firm level	No	No evidence of productivity spillovers
34.Girma, Sourafel & Holger Gorg (2002)	UK	1980-1992	Firm level	This paper focuses on the role of absorptive capacity in benefiting from spillovers from FDI.	This paper focuses on the role of absorptive capacity in determining whether or not domestic firms benefit from productivity spillovers from FDI. The results show that there is an evidence for a u-shaped relationship between productivity growth and FDI interacted with absorptive capacity, which suggests that improvements in absorptive capacity of firms may enhance their ability to benefit from spillovers from FDI.
35.Girma, Sourafel & Katharine Wakelin (2002)	UK	1988-1996	Firm level (OneSource Database)	Yes (positive horizontal spillovers)	Positive horizontal spillovers occur in the domestic firms (with the presence of multinational firms in the same sector and region).

36.Grog, Holger & Eric Strobl (2002)	Ghana	1991-1997	Firm level	Yes (positive horizontal spillovers)	Positive horizontal spillovers from labor mobility.
37.Gorg, Holger & Eric Strobl (2002)	Ireland	1973-1996	Plant level	Yes (positive horizontal spillovers)	Positive horizontal spillovers for indigenous plants in high-tech industries.
38.Ruane, Frances & Ali Ugur (2002)	Ireland	1991-1998	Plant level	No	No evidence of productivity spillovers (when the measurement of foreign presence is the MNC employment as a percentage of total employment). However, a weak evidence of productivity spillovers is found when foreign presence measures as the level of employment in foreign companies in the relevant sector.
39.Smarzynska, Beata K. (2002)	Lithuania	1996-2000	Firm level	Yes (positive vertical spillovers)	Positive vertical spillovers (the study shows that the existence of productivity spillovers from FDI taking place through contacts between foreign affiliates and their local suppliers in upstream sectors but there is no indication of spillovers occurring within the same industry).
40.Zukowska-Gagelmann, Katarzyna (2002)	Poland	1993-1997	Firm level	No (negative horizontal spillovers)	Negative horizontal spillovers for the most productive local firms in high competition industries & positive horizontal spillovers for the least productive local firms in low competition industries.
41.Blalock, Garrick & Paul Gertler (2003)	Indonesia	1988-1996	Firm level (panel)	Yes (positive vertical spillovers)	Strongly positive vertical spillovers from FDI.
42.Javorcik, B. S., B. (2003)	Lithuania	1996-2000	Firm level	Yes (positive vertical spillovers)	Positive vertical productivity spillovers. Morevoer, the results indicate that spillovers are associated with projects with shared domestic and foreign ownership but not with fully owned foreign investment.
43.Keller, Wolfgang & Stephen, Yeaple (2003)	US	1987-1996	Firm level	Yes (positive horizontal spillovers)	Positive horizontal spillovers form FDI (accouts for 14% of productivity growth of U.S. firm, FDI leads to significant productivity gains for domestic firms), also a evidence of imports-related spillovers.
44. Liu, Zhiqiang (2005)	China	1995-1999	Firm level	Yes (no horizontal but positive vertical spillovers)	No positive horizontal spillovers (negative short-run effects) but strong positive backward linkages.

45. Hu and Jefferson (2002)	China	1995-1999	Firm level	No (Negative horizontal spillovers)	Sample restricted to China's electronic and textile industries, drawn from the survey of large and medium enterprises conducted by the Chinese National Statistical Bureau. The authors find negative horizontal spillovers, although the impact is positive for firms receiving foreign investment.
46. Lin, Lui, and Zhang (2008)	China	1998-2005	Firm level	Yes (Positive forward spillovers, net zero horizontal spillovers)	They find that Hong Kong, Macao and Taiwan (HMT) invested firms generate negative horizontal spillovers, while Non-HMT foreign firms tend to bring positive horizontal spillovers. These two opposing horizontal effects seem to cancel out at the aggregate level. They also find forward spillover effects from all types of FDI.
47. Du, Harrison, and Jefferson (2008)	China	1998-2006	Firm level	Negative horizontal and weak forward spillovers	They find evidence of negative and significant horizontal spillovers and weak forward spillovers. They also find no evidence of positive backward spillovers. Firms with foreign investment exhibit higher productivity growth, particularly state-owned enterprises.