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DEVELOPMENT THROUGH SYNERGISTIC REFORM

James E. Rauch

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ABSTRACT

Several studies suggest that production of high-quality output is a precondition for firms in less developed countries to participate in the export market. Institutional deficiencies that raise the costs of entry into high-quality production therefore limit the positive impact that trade liberalization can have on income or growth. Institutional reform that reduces the costs of entry into high-quality production and trade reform therefore have synergistic effects on income and, possibly, growth. In contrast, institutional reform that reduces the costs of entry into low-quality production (e.g., reforms targeted at small businesses) interferes with the impact of trade reform. The model that yields these results is also used to analyze impacts of foreign direct investment and of subsidies to entrepreneurship in the presence of unemployment.

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1. Introduction

Liberalization of international trade was the centerpiece of the package of economic reforms undertaken by many less developed countries (LDCs) in the 1980s and 1990s. To date, the results of those reforms have been considered disappointing in terms of generating higher and more rapid growth of incomes in most of the reformers (Easterly 2001). A consensus has now emerged that a "second generation" of "institutional" reforms is necessary for the earlier reforms to have their expected impact, but as yet there is no consensus on how these institutions interact with trade liberalization or which should have priority for reform. Chang, Kaltani, and Loayza (2005) survey this literature and provide evidence from cross-country regressions that the interactions of trade openness with a number of different measures of infrastructure and institutions are positively associated with economic growth. Bolaky and Freund (2004) find that trade does not stimulate growth in economies that are heavily regulated, as measured using the *Doing Business* database.

This paper seeks to connect this literature to a parallel micro-level literature that examines the impact of exporting at the firm level and has, in its own way, also yielded disappointing results. The starting point for this literature was a well-established positive correlation between export market participation and firm productivity (and other "good" firm attributes, especially size). It was hoped that this correlation resulted from technology transfer or "learning by exporting." Beginning with Clerides, Lach, and Tybout (1998), however, most panel econometric studies have found that exporting does not increase firm productivity.

Instead, firms that are already more productive self-select into exporting, yielding the observed cross-sectional correlation.[1]

Does this mean that, for LDCs, the export market is no different from any other market? No, because success in the export market requires products of higher quality than those demanded in the domestic market. This is the message of studies at the firm level, including Brooks (2006) and Verhoogen (2006), and of studies of bilateral trade, such as Hallak (2006). It follows that we can expect little impact from reducing the anti-export bias of the economy if few firms are capable of producing goods of high (export) quality.[2]

This brings us back to the issue of institutional reform. Dixit (2004, Chapter 3) has shown how, in the area of contract enforcement, informal "institutions" (reputation) become inadequate once the economy grows beyond a certain size or complexity, after which formal-legal methods of contract enforcement are needed. It is not hard to see how his insight can be applied to the distinction between high- and low-quality production. High-quality production, especially for export, requires that certain standards be met, e.g., for pesticide residues in processed food or metal composition for medical instruments. High-quality producers depend on their suppliers in order to meet these standards. They must be confident that they can reject sub-standard shipments from their suppliers without interminable court battles, or else they may have

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[1]Some recent studies do in fact find evidence for learning by exporting, but none of these studies finds evidence *against* the selection mechanism described below. Fernandes and Isgut (2004, p. 2), who list these studies, point out that "self-selection and learning-by-exporting are not mutually exclusive possibilities, as high-productivity firms that can afford the sunk cost of entry to export markets may, in principle, continue to improve their productivity as a result of their exposure to exporting."

[2]A review of World Bank trade reform efforts from 1987 to 2004 found "rather modest export supply responses" (World Bank Independent Evaluation Group 2006, p. 40).

to integrate backwards – a significant barrier to entry.[3] Other institutional deficiencies can also pose barriers to entry for high-quality producers, especially insofar as they tend to be larger than low-quality producers. Bhidé (2004) notes that poor record-keeping means that land parcels in Bangalore, India often lack clean titles, potentially a much greater obstacle to a high-quality producer looking for a large, greenfield site for its plant. Laeven and Woodruff (2006) use data from a survey of lawyers in Mexico to show that firms are larger in states where the quality of the legal system is higher.

In contrast, governments and international development organizations have placed a great deal of emphasis on improving institutions that serve small- and medium-sized enterprises (SMEs), which tend not to be export-oriented and probably tend to produce relatively low-quality output. Reform of domestic lending practices to make credit more available to SMEs has been most prominent on this agenda, but there are many other initiatives such as programs that provide technology and marketing support (see, e.g., Beyene 2002). In principle, entrepreneurs who might have been willing to incur the high startup costs of large, export-oriented, high-quality production firms could choose to aim lower given the availability of such programs. I recognize, however, that some of the rationale for support of SMEs is employment generation rather than enhancing the benefits from trade liberalization, and take up the issue in that context in section 5 below.[4]

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[3]This argument is consistent with the results of Levchenko (forthcoming), who finds that countries with strong contract enforcement have a comparative advantage in goods requiring many intermediates in production.

[4]Most programs to support SMEs are more accurately viewed as subsidies rather than as efficiency-enhancing institutional reforms, and as such need to be justified by the presence of a distortion in the economy, such as one that creates unemployment. This is also true for programs

In short, trade liberalization has more impact when there are more export-quality producers, and institutional/regulatory reform that reduces obstacles to formation of firms capable of export-quality production has more impact when trade reform reduces anti-export bias. The impact of either policy reform without the other is limited.

In the next three sections of this paper I develop a model that yields these results while at the same time capturing the main features of the firm-level trade literature: self-selection of the most productive and largest firms into export-oriented, high-quality production; vertical differentiation of demand into low-quality, domestic and high-quality, (primarily) foreign; and industry "rationalization" effects from trade liberalization.[5] In section 5 I extend the model to cover foreign direct investment and domestic unemployment. Throughout, institutional reforms will simply be reflected in reductions in the fixed costs of entering high- or low-quality production; more detailed modeling will have to wait for research to pin down more decisively the institutions involved. Our aim is to show how changes in the costs of starting high- and low-quality producers, which can be attributed to institutional reforms, interact with trade liberalization in a model that captures the features of LDC economies found in the firm-level trade literature.

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specifically designed to help SMEs upgrade from low-quality production for the domestic market to high-quality production for export. Our argument regarding synergy pertains to efficiency-enhancing reforms, not subsidies, and prior to section 5 our model is constructed to avoid distortions.

[5]For a list of empirical studies finding that trade liberalization raises within-industry productivity in LDCs, see Goldberg and Pavcnik (2004, p. 21).

2. The model

Our model of self-selection of LDC firms into high-quality production for developed country markets is in the spirit of recent panel econometric studies that show a surge in investment prior to the start of exporting (Alvarez and López 2005, Lebedeva 2005). The authors interpret their findings as evidence that firms planning to export to developed countries first invest in raising the quality of their products. Their findings thus suggest that the main fixed cost of entering export markets is investment in raising quality, rather than the cost of exporting per se. I will simply assume that firms that produce high-quality goods gain access to more developed country markets, so that separate decisions are not made regarding whether to become a high-quality producer and whether to become an exporter. This modeling choice was also influenced by my interviews with CEOs of food-product exporters in Beirut during the first half of 2005. I learned that exporting was crucial to sustaining producers of high-quality goods because of their need to spread out their higher overhead relative to producers of low-quality goods. In other words, in LDCs the domestic market for high-quality goods is often too small to justify the investment in fixed assets and non-production staff necessary for high-quality production. For entrepreneurs in this situation, becoming a high-quality producer and becoming an exporter are decided jointly.[6] I therefore leave to future research construction of a model where some high-quality producers do not have access to more developed country markets.

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[6]Hallward-Driemeier, Iarossi, and Sokoloff (2002) show, for five East Asian countries, that firms that began as exporters differ systematically in the training of their work forces, the vintage of their capital equipment, the use of auditing, and other aspects of their production processes and operations, all of which is consistent with the need for these firms to achieve higher quality.

In other respects the model I construct builds upon ideas from Lucas (1978), Manasse and Turrini (2001), and Yeaple (2005). All three of these other papers postulate a distribution of talent across agents in the economy. In the models of Manasse and Turrini and of Yeaple, there are fixed costs of entry into the export market and the most talented agents will self-select into exporting. I will adopt the competitive market structure of Lucas rather than the monopolistically competitive market structure of Manasse and Turrini and of Yeaple. None of these models has a vertically differentiated demand structure that makes high quality a necessity for exporting. Ultimately, however, the differences between the issues addressed by this paper and those addressed by Lucas, Manasse and Turrini, and Yeaple are larger than the differences between the models.

Our model LDC has a population of mass N in which every agent is endowed with entrepreneurial talent z drawn from a fixed distribution F: $\mathbb{R}^+ \rightarrow [0,1]$, as in Lucas (1978). I also follow Lucas in assuming that entrepreneurial talent is irrelevant for employees (workers are homogeneous). Each agent has a choice of three careers: (1) he can become an employee and earn the prevailing wage w; (2) he can found and manage a firm that produces low-quality goods; or (3) he can found and manage a firm that produces high-quality goods. Low-quality goods are nontraded and high-quality goods are traded.[7]

[7]Allowing for imports of low-quality goods with which domestic producers have to compete would reinforce the results of this paper. Trade liberalization that lowered the cost of imported low-quality goods would have a greater impact on real income per capita if there were more firms producing high-quality goods and fewer firms producing low-quality goods, since the benefit to domestic consumers would be greater relative to the loss to domestic producers.

Productivity in this country is a function of cumulative production experience per capita $\overline{Q}$. We will discuss the growth of $\overline{Q}$ in section IV. For now, $\overline{Q}$ is a constant that plays no role in our analysis.

An agent with entrepreneurial talent *z* who chooses to become an entrepreneur producing low-quality goods must pay a fixed cost wC_L and thereby gain access to the production function

$$q_L = \overline{Q} f_L(z,\ell) \quad (1),$$

where ℓ is variable labor input and f_L is linear homogeneous in *z* and ℓ. He chooses ℓ to maximize profits given by $p_L q_L - w(\ell + C_L)$, where p_L is the price of low-quality goods that clears the domestic market. The result can easily be shown to be given by a profit function

$$\Pi_L = z\pi_L(p_L, w; \overline{Q}) - wC_L \quad (2),$$

where the function π_L is decreasing and convex in *w* and linear homogeneous in $\overline{Q}$ and w (and in p_L and *w*).

Some preliminary discussion is necessary before deriving the parallel profit function for producers of high-quality goods. The high quality manufactured product is treated as having a price p_H^* determined on world markets, and hence is assumed to be a perfect substitute for export-quality goods produced by other less developed countries. Opportunities for product differentiation are limited because LDC exporters typically do not sell to more developed country consumers under their own brand names (Gereffi 1994, 1999).[8] We have in mind

[8]The absence of distortions associated with a competitive market structure greatly simplifies the analysis of the impact of trade liberalization and institutional reforms on income in section 4 below.

instead the case where the marketing of products of LDC exporters to more developed country consumers is handled by MDC manufacturers, for which the LDC exporters play the role of "original equipment manufacturer" (OEM), or the case where the marketing of the LDC exporters' products is handled by MDC retailers under their "private labels." However, the LDC exporters must still bear the costs of shipment to their MDC buyers, which includes not only transportation costs but also communication costs involved in coordinating shipments with the buyers' needs. We model these costs as "melting" of exports, and assume in particular that for each unit shipped only a proportion $\rho < 1$ reaches an MDC buyer. The equilibrium domestic price for the LDC exporters is then $p_H = \rho p_H^*$. Finally, we will model the impact of "trade liberalization" as being transmitted entirely by increases in ρ or, equivalently, increases in p_H. By, in effect, restricting trade liberalization to reductions in communication and transportation costs, we avoid having to keep track of revenues from trade taxes (or expenditures from trade subsidies), which would clutter our model without yielding any additional insight from its analysis.[9]

An agent with entrepreneurial talent z who chooses to become an entrepreneur producing high-quality goods must pay a fixed cost wC_H, $C_H > C_L$, and thereby gain access to the production function

$$q_H = \overline{Q} f_H(z, \ell) \qquad (3),$$

where the notation follows equation (1). Profit maximization yields the profit function

$$\Pi_H = z\pi_H(w; p_H, \overline{Q}) - wC_H \qquad (4),$$

[9]In this section there are no market failures in our model, hence no policy motivation for trade taxes or subsidies.

where the function π_H has the properties of the function π_L, *mutatis mutandis*. I assume $\pi_H > \pi_L$ for all parameter values (and consequent values of the endogenous variables w and p_L) that I will consider, yielding greater scope to entrepreneurial talent in high-quality production.

Figure 1 plots profits given by equations (2) and (4) against entrepreneurial talent z. We see that the most talented entrepreneurs become founders of high-quality producers, those with less talent found low-quality producers, and agents with the least entrepreneurial talent become workers.[10] The cutoff levels of managerial talent, denoted by $\bar{z}$ and $\underline{z}$, are determined by

$$\bar{z}\pi_H(w;p_H,\overline{Q}) - wC_H = \bar{z}\pi_L(p_L,w;\overline{Q}) - wC_L \tag{5}$$

and

$$\underline{z}\pi_L(p_L,w;\overline{Q}) - wC_L = w \tag{6}.$$

It is clear from Figure 1 that exporting firms will tend to be larger than non-exporting firms measured by value of output (sales), though if low-quality production is more labor-intensive than high-quality production the smaller exporting firms could employ fewer workers than the larger non-exporting firms. It is also clear that exporting firms will tend to have higher measured productivity than those producing exclusively for the domestic market, since they have more talented entrepreneurs but entrepreneurial talent is unobserved.

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[10]Figure 1 is very similar to Figure 1 in Yeaple (2005), and both are examples of the Roy model of selection. In Yeaple's model high-technology (rather than high-quality) producers attract more talented *workers* (there are no entrepreneurs in his model). High-technology, exporting firms therefore pay higher wages. However, Fafchamps (2006) finds, using a panel of matched employer-employee data for Morocco, that the higher wages paid by exporting firms can be explained entirely by their larger size and greater capital intensity.

Turning to the demand side of the model, we want a specification that yields the result that only high-income consumers purchase high-quality goods. In a typical specification that yields this result, such as Flam and Helpman (1987), consumers obtain utility from a numéraire good, for which they choose the quantity to consume, and a vertically differentiated product, for which they choose the quality to consume, with the quantity restricted to one unit. In such a specification, an increase in the price of the low-quality good, say, reduces the quantity demanded only by reducing the number of consumers that choose the low-quality over the high-quality good. We generalize this specification so that an increase in the price of the low-quality good, say, also causes a reduction in the number of units consumed by each individual consumer that chooses this quality. This generalization increases realism and is also important for our results, as we shall see below.

We let the importable be the numéraire, denoting the quantity consumed by m, and denote the quantity and quality of the vertically differentiated product consumed by x and α, respectively. Consumer utility is given by

$$u(m,x,\alpha) = [m + a^{\sigma}x^{1-\sigma}/(1-\sigma)]\mu(\alpha), \quad \sigma > 0, \quad \sigma \neq 1$$

$$u(m,x,\alpha) = [m + a\ln(x/a)]\mu(\alpha), \quad \sigma = 1,$$

where $\mu(0) = 0$, $\mu' > 0$. Consumers can choose between a low-quality product with quality α_L and price p_L and a high-quality product with quality α_H and price p_H. It is then straightforward to show that individual consumer demand for the vertically differentiated product is given by either

$$x_L = a(p_L)^{-1/\sigma} \quad \text{or} \quad x_H = a(p_H)^{-1/\sigma}.$$

(Note that we can obtain the result that one unit is inelastically demanded by choosing $\sigma = \infty$ and $a = 1$.) Denoting the consumer's income by y, substituting either x_L or x_H into the consumer's

budget constraint to solve for *m*, and substituting the results for *m* and either x_L or x_H into the utility function yields

$$u_L = [y + \sigma a p_L^{1-1/\sigma}/(1-\sigma)]\mu(\alpha_L) \text{ or } u_H = [y + \sigma a p_H^{1-1/\sigma}/(1-\sigma)]\mu(\alpha_H),$$

where we focus on the case $\sigma \neq 1$ for the sake of brevity. The condition for the consumer to choose the high-quality good, $u_H > u_L$, then reduces to[11]

$$y > [a\sigma/(1-\sigma)][\mu(\alpha_L)p_L^{1-1/\sigma} - \mu(\alpha_H)p_H^{1-1/\sigma}]/[\mu(\alpha_H) - \mu(\alpha_L)].$$

The right-hand side of this expression is positive for $\sigma > 1$. For $\sigma < 1$, the right-hand side is positive provided $p_H/p_L > [\mu(\alpha_H)/\mu(\alpha_L)]^{\sigma/(1-\sigma)}$.

We thus have the desired result that there exists a cutoff level of income above which consumers purchase high-quality products and below which consumers purchase low-quality products. Moreover, this cutoff rises when the price of high-quality products increases and falls when the price of low-quality products increases, as one would expect. I assume the cutoff income level is above the wage for all parameter values (and consequent values of *w* and p_L) that I will consider. In this case the cutoff income level translates into a cutoff level of entrepreneurial talent $\hat{z}$. This cutoff could be between $\underline{z}$ and $\bar{z}$ or greater than $\bar{z}$. It seems unrealistic that entrepreneurs who run firms that produce high-quality output would not be rich enough to prefer to purchase high-quality output, so we focus on the case $\underline{z} < \hat{z} < \bar{z}$:

$$\hat{z}\pi_L(p_L, w; \overline{Q}) - wC_L = [a\sigma/(1-\sigma)][\mu(\alpha_L)p_L^{1-1/\sigma} - \mu(\alpha_H)p_H^{1-1/\sigma}]/[\mu(\alpha_H) - \mu(\alpha_L)] \qquad (7).$$

We can see from equation (7) that $\hat{z}$ is decreasing in p_L and increasing in p_H, as expected: fewer agents consume low-quality goods when their price rises and more agents consume low-quality

[11]The equivalent condition for $\sigma = 1$ is $y > a\{1 + [\mu(\alpha_L)\ln p_L - \mu(\alpha_H)\ln p_H]/[\mu(\alpha_H) - \mu(\alpha_L)]\}$.

goods when the price of high-quality goods rises. We also see that $\hat{z}$ is increasing in *w*: as wages rise, workers continue to consume low quality goods and entrepreneurs become poorer, causing some to shift from high- to low-quality consumption.

With both the demand and supply sides of the model in place, we need only state the market clearing conditions. For labor, we have

$$-\int_{\bar{z}}^{\infty}(\partial\Pi_H/\partial w)dF-\int_{\underline{z}}^{\bar{z}}(\partial\Pi_L/\partial w)dF=\int_0^{\underline{z}}dF \qquad (8),$$

and for low-quality goods, we have

$$ap_L^{-1/\sigma}\int_0^{\hat{z}}dF=\int_{\underline{z}}^{\bar{z}}(\partial\Pi_L/\partial p_L)dF \qquad (9),$$

where *N* has cancelled out on both sides of equations (8) and (9). Finally, denoting the total quantity (and value) of imports by *M*, balanced trade requires

$$M=p_H\left(\int_{\bar{z}}^{\infty}(\partial\Pi_H/\partial p_H)dF-ap_H^{-1/\sigma}\int_{\hat{z}}^{\infty}dF\right)N \qquad (10).$$

3. Model solution and comparative statics

Equations (5) - (9) form a system of five equations in the five unknowns $\bar{z}$, $\underline{z}$, $\hat{z}$, *w*, and p_L. Equation (10) then determines the volume of imports. It is already evident from Figure 1 (which incorporates equations (5) and (6)) and from equation (7) that the cutoffs $\bar{z}$, $\underline{z}$, and $\hat{z}$ are uniquely determined given values of *w* and p_L. To show that a solution for our model exists and is unique, we therefore need only show that a unique solution exists for *w* and p_L. I will do this by showing in the Appendix that the labor and goods market-clearing conditions (equations (8)

and (9)) can be plotted in w, p_L space as illustrated in Figure 2. Here I will give the intuition behind this figure.

Consider first the labor market-clearing curve. Increasing w decreases labor demand of both high- and low-quality producers, whereas increasing p_L increases labor demand only for low-quality producers, so p_L must increase more than w to maintain demand equal to supply. Hence the wage in terms of low-quality goods falls as we move up along the labor market-clearing curve. Moreover, we can see that this curve must intersect the horizontal axis: as p_L goes to zero, demand for labor by low-quality producers goes to zero but demand for labor by high-quality producers remains positive, hence the wage that clears the labor market remains positive.[12]

Now consider the goods market-clearing curve. Increasing w only decreases the supply of low-quality goods whereas increasing p_L both increases the supply and decreases the demand, so w must increase more than p_L to maintain supply equal to demand. Hence the wage in terms of low-quality goods rises as we move up this curve.

In the Appendix, I prove:

Proposition 1: There exist unique values of w, p_L, $\bar{z}$, $\underline{z}$, and $\hat{z}$ that satisfy equations (5), (6), (7), (8), and (9), under the sufficient condition that the difference between the labor demands of the smallest high-quality producer and the largest low-quality producer is small enough ($-\partial\Pi_H(\bar{z})/\partial w + \partial\Pi_L(\bar{z})/\partial w$ is small enough in absolute value).[13]

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[12]Figure 2 shows a constant slope for the labor market-clearing curve, but actually it must become vertical as p_L approaches zero because p_L can no longer affect labor demand once no entrepreneurs choose to found low-quality firms.

[13]This difference is determined by two opposing factors: on the one hand, the smallest high-quality producer has a higher fixed cost measured in labor; on the other hand, the largest low-quality producer can realistically be assumed to have a more labor-intensive technology. We assume that these factors are roughly in balance for the marginal firm.

Throughout the remainder of the paper we assume that the sufficient condition stated in Proposition 1 holds. In particular, for brevity we will not restate it in subsequent propositions.

We are now ready to do comparative static analysis. The key parameters whose impacts we want to examine are the price received by high-quality producers p_H, which rises with trade liberalization, and the costs of founding high- and low-quality producers, respectively C_H and C_L. I analyze decreases in these costs, representing institutional reform.

I first analyze the impact of an increase in p_H, representing trade liberalization. This increases the demand for labor, shifting the labor market-clearing curve right, and increases the demand for low-quality goods, shifting the goods market-clearing curve up. The wage and the price of low-quality goods therefore increase unambiguously. We can then prove $dp_H/p_H > dw/w > dp_L/p_L$, so that w/p_H falls and w/p_L rises. The proof starts with consideration of the limiting case of zero price elasticity of demand for low-quality goods. We can see that for $\sigma = \infty$ equations (5) - (9) are homogeneous of degree zero in p_H, w, and p_L, i.e., that p_H, w, and p_L can be increased in the same proportion without changing the values of $\bar{z}$, $\underline{z}$, and $\hat{z}$ that satisfy equations (5) - (9). Since increasing p_H causes the labor market-clearing curve in Figure 2 to shift right and the goods market-clearing curve in Figure 2 to shift up, it must be that the intersection of these two curves moves up along a ray from the origin when p_H increases. As σ falls, the upward shift of the goods market-clearing curve in response to the increase in p_H decreases (because p_L needs to increase less to clear the market for low-quality goods), so for a negative price elasticity of demand for low-quality goods the new intersection of the labor and goods market-clearing curves in Figure 2 must fall below the ray through the origin that passes through their original intersection. It follows that w increases proportionately more than p_L and

therefore, from equation (6), $\underline{z}$ must rise. Finally, the point on the labor market-clearing curve that intersects the ray from the origin through the original equilibrium corresponds to equi-proportionate increases in p_H, w, and p_L, i.e., equations (5), (6), and (8) are satisfied by equi-proportionate increases in p_H, w, and p_L. Since the goods market-clearing curve does not shift up far enough to put the new equilibrium at this point, w must increase proportionately less than p_H. The fall in w/p_H and rise in w/p_L both ensure that $\bar{z}$ falls when p_H increases.

We have thus proven:

Proposition 2: Trade liberalization has an "industry rationalization" effect: it causes the least efficient firms to exit ($d\underline{z}/dp_H > 0$) and increases the average productivity (exclusive of sunk costs) of the mix of firms that are present both before and after trade liberalization ($d\bar{z}/dp_H < 0$). Trade liberalization also increases the output of every firm that produces high-quality goods and reduces the output of every firm that produces low-quality goods, since $\partial\Pi_H/\partial p_H$ and $\partial\Pi_L/\partial p_L$ are homogeneous of degree zero in the wage and output price and trade liberalization causes a fall in w/p_H and a rise in w/p_L.

I now analyze the impacts of institutional reform, i.e., decreases in C_H and C_L, the costs of founding high- and low-quality producers, respectively. A decrease in C_H has a direct negative effect on $\bar{z}$, the cutoff talent level for high-quality entrepreneurship. In the Appendix I derive the sufficient conditions that insure this direct effect will not be offset by indirect effects, so that the number of firms producing high-quality goods increases. A decrease in C_L has a direct positive effect on $\bar{z}$ (and direct negative effects on $\underline{z}$ and $\hat{z}$). In the Appendix I derive the sufficient conditions that insure this direct effect will not be offset by indirect effects, so that the number of firms producing high-quality goods decreases.

A reduction in costs common to starting high- and low-quality producers, such as a decrease in business registration fees, can cause equal decreases in C_H and C_L. This has a direct

negative effect on $\underline{z}$ (and on $\hat{z}$). In the Appendix I derive the sufficient conditions that insure this direct effect will not be offset by indirect effects, so that the total number of firms increases.

These and other comparative static results are shown in Table 1. The following proposition is proved in the Appendix:

Proposition 3: A small enough value of σ is sufficient for the results shown in Table 1 to hold, except for $d\underline{z}/dC_L > 0$ and $d\hat{z}/dC_L > 0$, which require that the ambiguous changes in w and p_L do not offset the direct effects of C_L on $\underline{z}$ and $\hat{z}$ in equations (6) and (7), respectively.

4. Interactions between trade liberalization and institutional reform

We begin by analyzing synergy or interference between the effects of trade liberalization and the effects of institutional reform on the level of real income. The value of income per capita is equal to the sum of profits and wages per capita, which is given by

$$GNP = \int_{\bar{z}}^{\infty} \Pi_H dF + \int_{\underline{z}}^{\bar{z}} \Pi_L dF + w\int_0^{\underline{z}} dF \qquad (11).$$

The impacts of C_H, C_L, and p_H on GNP can then be shown to be given by, respectively,

$$dGNP/dC_H = -\int_{\bar{z}}^{\infty} w dF + \left(\int_{\underline{z}}^{\bar{z}} \left(\partial \Pi_L / \partial p_L\right) dF\right) dp_L/dC_H \qquad (12),$$

$$dGNP/dC_L = -\int_{\underline{z}}^{\bar{z}} w dF + \left(\int_{\underline{z}}^{\bar{z}} \left(\partial \Pi_L / \partial p_L\right) dF\right) dp_L/dC_L \text{ , and} \qquad (13)$$

$$dGNP/dp_H = \int_{\bar{z}}^{\infty} \left(\partial \Pi_H / \partial p_H\right) dF + \left(\int_{\underline{z}}^{\bar{z}} \left(\partial \Pi_L / \partial p_L\right) dF\right) dp_L/dp_H \qquad (14).$$

Equations (12) - (14) each include a term that equals the increase in the value of output of low-quality goods in response to an increase in p_L. Since all low quality goods are consumed domestically, this term is exactly equal to the increase in expenditure required to purchase the low-quality goods produced and therefore does not reflect an increase in real income. Similarly, we want to deduct the increase in expenditure required to purchase the high-quality goods produced from the increase in income caused by trade liberalization in equation (14). These adjustments yield the following changes in real income per capita or *RGNP*:

$$dRGNP/dC_H = -\int_{\bar{z}}^{\infty} w dF \qquad (12'),$$

$$dRGNP/dC_L = -\int_{\underline{z}}^{\bar{z}} w dF \quad \text{, and} \qquad (13')$$

$$dRGNP/dp_H = \int_{\bar{z}}^{\infty} (\partial \Pi_H / \partial p_H) dF - a p_H^{-1/\sigma} \int_{\hat{z}}^{\infty} dF \qquad (14').$$

We see that the increases in real income resulting from decreases in C_H or C_L equal the value of the labor resources saved by reducing the fixed costs of founding producers of high-quality and low-quality goods, respectively. By comparing equation (14′) to equation (10), we see that the increase in real income resulting from trade liberalization, modeled here as a reduction in the real costs of bringing exportables to the international market, equals the increase in imports that can be purchased in exchange for exports: the terms of trade effect. These standard results reflect the lack of any distortions in our model.

We can now prove our main results.

Proposition 4: The impact of trade liberalization on real income is enhanced by institutional reform that reduces startup costs for producers of high-quality goods, under the sufficient

conditions that σ is small enough and that the technology for high-quality goods is productive enough. Proof: From equation (14′) we see that $dRGNP/dp_H$ increases as $\bar{z}$ falls, as w falls, and as $\hat{z}$ rises. According to Proposition 3, a reduction in C_H has the first two effects under the sufficient condition that σ is small enough. The impact of a reduction in C_H on $\hat{z}$ is ambiguous, but if it is negative we can see from equation (14′) that it will be dominated by the impact on $\bar{z}$ provided the technology for high-quality goods is productive enough, so that $\partial\Pi_H/\partial p_H$ is large enough relative to $ap_H^{-1/\sigma}$.■

The key to Proposition 4 is the direct effect that changing C_H has on the number of firms that produce high-quality goods and hence participate in the export market. The converse of this proposition is equally important: dysfunctional institutions that raise C_H can make the impact of trade liberalization on real income arbitrarily small.

A corollary to Proposition 4 is that trade liberalization and institutional reform that reduces startup costs for high-quality producers have the property that "the whole is greater than the sum of its parts": the two reforms enacted together have a greater impact on real income than the sum of their separate impacts.

Corollary 1 (Synergy): Under the sufficient conditions stated in Proposition 4, an increase in p_H and a decrease in C_H together have a larger positive impact on real income than the sum of the separate impacts from an increase in p_H and a decrease in C_H. Proof: Denote the initial level of real income by $RGNP(p_H^0,C_H^0)$ and the level of real income following an increase in p_H and a decrease in C_H by $RGNP(p_H^1,C_H^1)$. We can decompose the change in real income as follows: $RGNP(p_H^1,C_H^1) - RGNP(p_H^0,C_H^0) = [RGNP(p_H^1,C_H^1) - RGNP(p_H^0,C_H^1)] + [RGNP(p_H^0,C_H^1) - RGNP(p_H^0,C_H^0)]$. By Proposition 4, the first change is larger than $RGNP(p_H^1,C_H^0) - RGNP(p_H^0,C_H^0)$, the separate impact on real income of an increase in p_H, and the second change equals the separate impact on real income of a decrease in C_H.■

It is important to note that Corollary 1 implies that the impact on real income of institutional reform that reduces startup costs for high-quality producers will be greater post-trade liberalization than pre-trade liberalization.

Institutional reforms that reduce startup costs for low-quality producers have the opposite implications for the efficacy of trade liberalization.

Proposition 5: The impact of trade liberalization on real income is reduced by institutional reform that reduces startup costs for producers of low-quality goods, under the sufficient conditions that σ is small enough, that the technology for high-quality goods is productive enough, and that dw/dC_L is small enough. Proof: From equation (14′) we see that $dRGNP/dp_H$ decreases as $\bar{z}$ rises, as w rises, and as $\hat{z}$ falls. According to Proposition 3, a reduction in C_H has the first effect under the sufficient condition that σ is small enough. It is unclear whether a reduction in C_H has the second effect, so we must assume that any decrease in the wage is sufficiently small that it is offset by the first effect. The direct effect of a reduction in C_L is to reduce $\hat{z}$, but if its ambiguous effects on w and p_L reversed this direct effect, the impact on $dRGNP/dp_H$ will be dominated by the impact on $dRGNP/dp_H$ through $\bar{z}$ provided the technology for high-quality goods is productive enough.■

The key to Proposition 5 is the direct negative effect that reducing C_L has on the number of firms that produce high-quality goods and hence participate in the export market.

Corollary 2 (Interference): Under the sufficient conditions stated in Proposition 5, an increase in p_H and a decrease in C_L together have a smaller positive impact on real income than the sum of the separate impacts from an increase in p_H and a decrease in C_L. Proof: The proof follows that of Corollary 1, *mutatis mutandis*, and is therefore omitted.■

Table 1 suggests that equal reductions in the startup costs for producers of high- and low-quality goods are roughly neutral with regard to the impact of trade liberalization on real income as given by equation (14′). The direct effects on $\bar{z}$ of decreases in C_H and C_L cancel out. The only unambiguous impact on $dRGNP/dp_H$ is negative, through reduction in $\hat{z}$, but this is relatively small if we maintain the condition in Propositions 4 and 5 that $\partial\Pi_H/\partial p_H$ is large relative to $ap_H^{-1/\sigma}$.

Synergy and interference with potential growth effects of trade liberalization

Our model can be adapted fairly easily to allow for endogenous productivity growth through unbounded learning-by-doing. This endogenous growth mechanism was introduced by Lucas (1988) and applied in a small-country LDC model by Matsuyama (1992). We can then derive the impact of trade liberalization on the productivity growth rate, and see how that impact changes with institutional reform. Since unbounded learning-by-doing is only one of several endogenous growth mechanisms that could be influenced by trade liberalization, our results should only be taken as suggestive of how a growth effect of trade liberalization could be enhanced or reduced by institutional reforms.

We assume that high- and low-quality output adds to cumulative production experience per capita with weights γ_H and γ_L, respectively:

$$d\overline{Q}/dt = \gamma_H \int_{\bar{z}}^{\infty} (\partial \Pi_H / \partial p_H) dF + \gamma_L \int_{\underline{z}}^{\bar{z}} (\partial \Pi_L / \partial p_L) dF \qquad (15).$$

We see from equation (15) that the output of any one firm cannot affect the accumulation of production experience. It follows that sectoral production experience is a purely external economy for the firms producing the vertically differentiated good, as is standard in models of endogenous growth through learning-by-doing. Since Π_H and Π_L are both linear homogeneous in $\overline{Q}$ and *w*, we can write the percentage change in cumulative production experience as

$$(d\overline{Q}/dt)/\overline{Q} = \gamma_H \int_{\bar{z}}^{\infty} (\partial \tilde{\Pi}_H / \partial p_H) dF + \gamma_L \int_{\underline{z}}^{\bar{z}} (\partial \tilde{\Pi}_L / \partial p_L) dF \qquad (16),$$

where

$$\tilde{\Pi}_H(C_H, p_H, w/\overline{Q}, z) \equiv \Pi_H(C_H, p_H, 1, w/\overline{Q}, z) \text{ and } \tilde{\Pi}_L(C_L, p_L, w/\overline{Q}, z) \equiv \Pi_L(C_L, p_L, 1, w/\overline{Q}, z).$$

By equations (1) and (3), equation (16) gives the percentage change in total factor productivity for both low- and high-quality production. Growth of productivity will cause a decline in the ratio of low-quality to high-quality production because preferences are non-homothetic.[14] This may be a realistic property of our model, but it means that in general the growth of productivity given by equation (16) will not be constant. With a slight modification, however, our model yields a constant rate of total factor productivity growth that in turn equals a constant rate of income growth and a constant rate of utility growth. We can modify consumer preferences so that, as productivity increases, so does the "productivity" of the vertically differentiated product in utility: we can let the parameter *a* in the utility function equal $\lambda \overline{Q}$, so that demand for the vertically differentiated product grows at the same rate as productivity and therefore at the same rate as income, just as though preferences were homothetic. With this modification, equations (7) and (9) become

$$\hat{z}\pi_L(p_L, w; \overline{Q}) - wC_L = [\lambda \overline{Q}\ \sigma/(1-\sigma)][\mu(\alpha_L)p_L^{1-1/\sigma} - \mu(\alpha_H)p_H^{1-1/\sigma}]/[\mu(\alpha_H) - \mu(\alpha_L)] \qquad (7')$$

and

$$\lambda \overline{Q} p_L^{-1/\sigma} \int_0^{\hat{z}} dF = \int_{\underline{z}}^{\bar{z}} (\partial \Pi_L / \partial p_L) dF \qquad (9').$$

It is easy to see that the modified model, consisting of equations (5), (6), (7′), (8), and (9′), yields a constant rate of productivity growth equal to a constant rate of income and utility growth:

---

[14]Productivity growth will drive down p_L but not p_H because the latter is fixed through competition in the international market. As a result, entrepreneurs will shift out of low-quality production into high-quality production ($\bar{z}$ will fall).

equiproportional increases in $\overline{Q}$ and *w* leave the solutions for $\bar{z}$, $\underline{z}$, $\hat{z}$, and p_L unchanged, so that $(d\ \overline{Q}\ /dt)/\ \overline{Q}$ is constant by equation (16) and the percentage changes in wages, income, and utility must all equal the percentage changes in cumulative production experience.

Total differentiation of equation (16) with respect to p_H yields

$$
\begin{aligned}
&(d/dp_H)[(d\overline{Q}/dt)/\overline{Q}] = \gamma_H \int_{\bar{z}}^{\infty} (d/dp_H)(\partial \tilde{\Pi}_H/\partial p_H)dF + \gamma_L \int_{\underline{z}}^{\bar{z}} (d/dp_H)(\partial \tilde{\Pi}_L/\partial p_L)dF \\
&+ \gamma_L[(\partial \tilde{\Pi}_L(\bar{z})/\partial p_L)(d\bar{z}/dp_H)dF(\bar{z}) - (\partial \tilde{\Pi}_L(\underline{z})/\partial p_L)(d\underline{z}/dp_H)dF(\underline{z})] \\
&- \gamma_H(\partial \tilde{\Pi}_H(\bar{z})/\partial p_H)(d\bar{z}/dp_H)dF(\bar{z})
\end{aligned}
\qquad (17).
$$

For a given value of $\overline{Q}$, the value of $(d/dp_H)[\ (d\ \overline{Q}\ /dt)/\ \overline{Q}\ ]$ is the same whether we use our original or modified model, but for the modified model it equals the impact of trade liberalization on the steady state rate of income growth, rather than just the impact of trade liberalization on productivity growth at the initial level of cumulative production experience.

From Proposition 2, we know that $(d/dp_H)(\partial\ \tilde{\Pi}_H/\partial p_H) > 0$ and $(d/dp_H)(\partial\ \tilde{\Pi}_L/\partial p_L) < 0$:

for a given level of cumulative production experience, trade liberalization raises the output of every high-quality producer and lowers the output of every low-quality producer. Moreover, we know from Proposition 3 that institutional reform that lowers startup costs for high-quality

producers raises the number of them, and also lowers the number of low-quality producers if the unambiguous effect on $\bar{z}$ dominates the ambiguous effect on $\underline{z}$. Conversely, we know from Proposition 3 that institutional reform that lowers startup costs for low-quality producers raises the number of them and lowers the number of high-quality producers. We can therefore state:

Proposition 6: Under the sufficient conditions given in Proposition 3, a decrease in C_L increases the number of firms for which trade liberalization reduces output and decreases the number of firms for which trade liberalization raises output, and a decrease in C_H increases the number of firms for which trade liberalization raises output. A decrease in C_H also decreases the number of firms for which trade liberalization reduces output if its unambiguous effect on $\bar{z}$ dominates its ambiguous effect on $\underline{z}$.

In an economy where productivity growth is driven by growth in cumulative production experience, Proposition 6 creates a presumption that institutional reform that lowers startup costs for high-quality producers will cause trade liberalization to increase productivity growth more (or decrease it less), whereas institutional reform that lowers startup costs for low-quality producers has the opposite effect. A presumption is not a proof, however, and I have not been able to sign the impact of a decrease in C_H or C_L on $(d/dp_H)[\ (d\ \overline{Q}\ /dt)/\ \overline{Q}\ ]$ as given by equation (17).[15]

5. Extensions of the model

A. Foreign Direct Investment

[15]I have simulated the model and found for the case $\gamma_H = \gamma_L$ that $(d/dp_H)[\ (d\ \overline{Q}\ /dt)/\ \overline{Q}\ ]$ increases monotonically as C_H falls and can change from negative to positive.

We have seen that the number of firms that produce high-quality output will be increased by institutional reform that reduces startup costs for high-quality producers. An alternative way to increase the number of such firms is to increase the number of foreign subsidiaries operating in the country. It is easy to add this feature to our model. We simply increase the mass of agents with entrepreneurial talent greater than $\bar{z}$ from $N[1 - F(\bar{z})]$ to $(1 + s)N[1 - F(\bar{z})]$, where $sN[1 - F(\bar{z})]$ is the mass of foreign subsidiaries. For the purpose of comparative statics we will fix $\bar{z}$ in this expression at $\bar{z}^0$, i.e., we will treat the mass of foreign subsidiaries as an exogenous variable.[16] For example, this mass could be determined by government licensing agreements.

The presence of foreign subsidiaries changes the labor market-clearing condition, but leaves equations (5) - (7) and (9) unchanged since the foreign entrepreneurs do not become low-quality producers nor do they consume low-quality output:

$$-(1+s)\int_{\bar{z}}^{\infty}(\partial\Pi_H/\partial w)dF-\int_{\underline{z}}^{\bar{z}}(\partial\Pi_L/\partial w)dF=\int_0^{\underline{z}}dF \qquad (8').$$

It follows that the only direct impact of an increase in the mass of foreign subsidiaries is to increase the demand for labor, thereby shifting the labor market-clearing curve right in Figure 2. It is then straightforward to prove the following changes in the endogenous variables:

Proposition 7: An increase in s causes w, p_L, and w/p_L to increase, which in turn imply increases in $\underline{z}$ and $\bar{z}$. The impact of s on $\hat{z}$ is ambiguous.

From Proposition 7 we see that foreign direct investment causes output of all domestic producers to decrease, the least productive domestic firms to exit the industry, and the least productive

[16]At the cost of additional notation, we could choose any $z > \bar{z}$ without affecting the analysis.

domestic high-quality producers to shift to low-quality production. The reduction in output of domestic firms is consistent with the findings of Aitken and Harrison (1999).

The impact of an increase in foreign direct investment on real income per capita can be shown to equal the per capita increase in wages paid to employees of existing foreign subsidiaries, just as in standard models:

$$dRGNP/ds = -s(dw/ds)\int_{\bar{z}}^{\infty}(\partial \Pi_H/\partial w)dF > 0 \qquad (18).$$

Since profits earned by foreign entrepreneurs are not included in *RGNP*, their reduction as a result of an increase in the wage is not subtracted from the impact on *RGNP* of an increase in foreign direct investment. The same logic implies that the presence of foreign subsidiaries alters the impact on real income per capita of changes in other model parameters. In particular, to compute the impact on *RGNP* of trade liberalization, we must now add to the expression in equation (14′) the expression given in equation (18), substituting dw/dp_H for dw/ds in the latter. In this respect foreign direct investment enhances the impact of trade liberalization on *RGNP*, because the increase in wages resulting from trade liberalization is no longer completely offset by lost profits of domestic firms. On the other hand, an increase in *s* tends to decrease $dRGNP/dp_H$ because it decreases the number of domestic high-quality producers and the output of each of them.

B. Subsidizing entrepreneurship and synergy in the presence of unemployment

Subsidies to entrepreneurship usually take the form of programs to aid small businesses. Since small businesses tend to be more labor-intensive than large businesses, this is consistent with the motivation of generating employment. In its present form our model cannot address this motivation. To the extent that such subsidies lead entrepreneurs to found low- rather than high-quality producers, we have seen that they will work at cross-purposes with trade liberalization. However, if these kinds of programs are targeted at sufficiently small businesses (with less than ten employees, say), it can be argued that they will not induce entrepreneurs to substitute away from founding high-quality producers. In fact, we will see that this kind of subsidy can be justified in our model in the presence of a distortion that creates unemployment. Moreover, with such a subsidy in place, the argument for synergy (interference) between the impact of trade liberalization on real income per capita and institutional reform that reduces startup costs for high- (low-) quality producers is probably strengthened.

We can extend our model to two types of agents: skilled (educated) and unskilled. We assume that only skilled agents can become entrepreneurs, as in Rauch (1991), so the distribution of entrepreneurial talent among unskilled agents is irrelevant. We also assume that there exists a binding minimum wage $\underline{w}$ for unskilled labor that creates unemployment. Greater employment of unskilled labor then implies higher real income per capita, all else equal.[17]

Surprisingly few modifications are needed in equations (5) - (9) to incorporate these changes. All profit functions now include the parameter $\underline{w}$. Any fixed costs requiring unskilled labor can be subtracted in equations (5) and (6). Demand for low-quality goods on the part of

[17]To the extent that the unemployed engage in some other activity, such as home production, the loss of this output must be subtracted from any measured increase in real income resulting from greater employment.

employed unskilled workers must be added to the left-hand side of equation (9). We will proceed on the assumption that these modifications leave the comparative static results summarized in Table 1 intact.[18]

Income per skilled agent can now be written as

$$GNP = \int_{\bar{z}}^{\infty} \Pi_H \, dF + \int_{\underline{z}}^{\bar{z}} \Pi_L \, dF + w \int_0^{\underline{z}} dF - \underline{w} \left(\int_{\bar{z}}^{\infty} (\partial \Pi_H / \partial \underline{w}) dF + \int_{\underline{z}}^{\bar{z}} (\partial \Pi_L / \partial \underline{w}) dF \right) \qquad (11'),$$

where the term with $\underline{w}$ gives the sum of wages paid to unskilled workers employed in high- and low-quality production. Consider a small subsidy to entrepreneurship that only affects skilled agents at the margin between becoming entrepreneurs and becoming workers, i.e., it only enters equation (6). This small subsidy will reduce $\underline{z}$.[19] If the positive effect of the reduction in $\underline{z}$ on employment of unskilled workers dominates any offsetting effects operating through w and p_L, the small subsidy must increase real income per capita. As the small subsidy becomes large, however, there are income losses due to skilled agents becoming entrepreneurs whose contribution to income as workers was strictly larger, while the employment benefit from reductions in $\underline{z}$ shrinks as less talented entrepreneurs become employers. This suggests that there exists a positive, finite optimal subsidy to small businesses in our model in the presence of a

[18]The key sufficient condition on employment, that $-\partial \Pi_H(\bar{z})/\partial w + \partial \Pi_L(\bar{z})/\partial w$ is small in absolute value, is less tenable now that it refers to skilled workers only. However, this condition is only sufficient, not necessary. The assumption that the price elasticity of demand for the low-quality good is sufficiently high is even more important than before.

[19]As with the result that a fall in C_L decreases $\underline{z}$, we need to make the additional assumption that any rise in w is too small to offset the direct negative effect of the subsidy on $\underline{z}$.

minimum wage. (The best policy to address unemployment in our modified model is a wage subsidy, of course.)

We now consider the impact of trade liberalization on income per skilled agent expressed in equation (11′). For simplicity we assume that the optimal subsidy described in the preceding paragraph is in place, in which case trade liberalization has no impact on *GNP* through $\underline{z}$. We have:

$$
\begin{aligned}
dGNP/dp_H = {} & \int_{\bar{z}}^{\infty} \left(\partial \Pi_H / \partial p_H\right) dF + \left(\int_{\underline{z}}^{\bar{z}} \left(\partial \Pi_L / \partial p_L\right) dF \right) dp_L / dp_H \\
- \underline{w} \Bigg(& \int_{\bar{z}}^{\infty} \left(\partial^2 \Pi_H / \partial \underline{w} \partial p_H\right) dF + \left(\int_{\underline{z}}^{\bar{z}} \left(\partial^2 \Pi_L / \partial \underline{w} \partial p_L\right) dF \right) dp_L / dp_H + \\
& \left(\int_{\bar{z}}^{\infty} \left(\partial^2 \Pi_H / \partial \underline{w} \partial w\right) dF + \int_{\underline{z}}^{\bar{z}} \left(\partial^2 \Pi_L / \partial \underline{w} \partial w\right) dF \right) \left(dw / dp_H\right) + \\
& \left(\partial \Pi_L(\bar{z}) / \partial \underline{w}\right) dF(\bar{z}) - \left(\partial \Pi_H(\bar{z}) / \partial \underline{w}\right) dF(\bar{z}) \Bigg)
\end{aligned}
\tag{19}
$$

The first two terms in equation (19) are familiar from equation (14) and yield the increase in real income per skilled agent given in equation (14′). The next term equals the minimum wage times the direct increase in employment of unskilled labor resulting from the higher price of output received by high-quality producers. The next three terms reflect the fact that trade liberalization continues to shift the labor market-clearing curve in Figure 2 to the right and the goods market-clearing curve up, so that w and p_L will increase. The term including dp_L/dp_H equals the minimum wage times the indirect increase in employment of unskilled labor resulting from the

higher price of output received by low-quality producers. The terms involving the change in the wage of skilled labor are ambiguous in sign, because firms should substitute unskilled for skilled labor but the increase in cost should cause output to contract. The last two terms offset each other, leaving their net effect ambiguous.

To summarize, if we set aside the ambiguous terms in equation (19), increased wage income due to increased employment of unskilled workers in both high- and low-quality production augments the positive terms of trade effect of trade liberalization on real income. The impact of trade liberalization on unskilled employment in low-quality production is smaller, the higher is the price elasticity of demand for low-quality goods and hence the less their price rises in response to the increase in demand that trade liberalization causes. The direct effect of institutional reform that lowers the startup costs for high-quality producers will increase (decrease) the employment effect of trade liberalization for high- (low-) quality producers by increasing (decreasing) the number of high- (low-) quality producers. It follows that if the price elasticity of demand for low-quality goods is sufficiently large, there is a presumption that the synergy between this institutional reform and trade liberalization is enhanced by the existence of unemployment of unskilled labor. Under the same condition and following the same reasoning, there is a presumption that the interference is stronger between trade liberalization and institutional reform that reduces the startup costs for low-quality producers.

Finally, we note that since the wage of unskilled workers is fixed at $\underline{w}$, trade liberalization raises the wage of skilled workers relative to that of unskilled workers. This is consistent with a number of studies of the impact of trade liberalization on wage inequality in LDCs (see Goldberg

and Pavcnik 2004 for a survey). The real wage of unskilled workers actually falls because the price of low-quality goods rises.

6. Conclusions

We constructed a model of a small, open less developed country that displays now well-known responses to trade liberalization: the least efficient firms exit and more efficient firms expand at the expense of less efficient firms, yielding an increase in average productivity. We then showed that in this model institutional reform that reduces the costs of entry into high-quality production and trade liberalization have synergistic effects on income. In contrast, institutional reform that reduces the costs of entry into low-quality production interferes with the effect of trade liberalization on income. We also used the model to analyze the impacts of foreign direct investment and of subsidies to entrepreneurship in the presence of unemployment.

Our results should help to narrow down the focus of institutional reform efforts in less developed countries. In particular, they suggest that less developed countries seeking to benefit from liberalized trade could concentrate on reform of institutions that differentially affect high-quality producers relative to all producers. This should be more feasible than trying to tackle the entire universe of institutional reforms.

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Table 1: Comparative statics

Change in parameter:	Resulting change in: $\bar{z}$	$\underline{z}$	$\hat{z}$	w	p_L
Decrease in C_H	**–**	**?**	**?**	**–**	**?**
Decrease in C_L	**+**	**–**	**–**	**?**	**?**
Equal decrease in C_H and C_L	**?**	**–**	**–**	**?**	**?**
Increase in p_H	**–**	**+**	**+**	**+**	**+**

Bold: Change in $\bar{z}$, $\underline{z}$, or $\hat{z}$ results from direct effect of change in parameter in equation (5), (6), or (7), respectively; or change in w or p_L results from reinforcing shifts of curves in Figure 2.

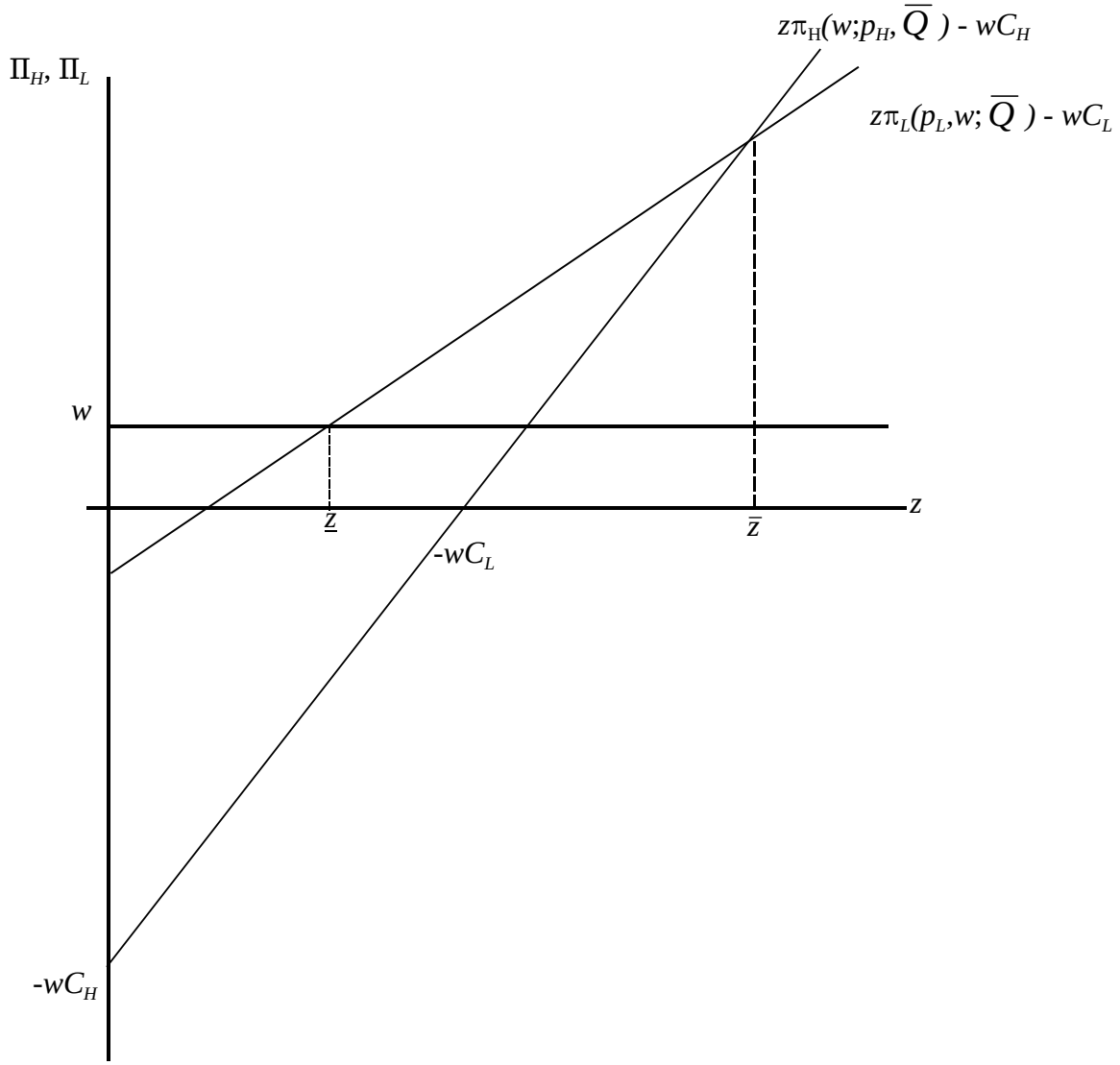

Figure 1: Determination of cutoff levels of entrepreneurial talent

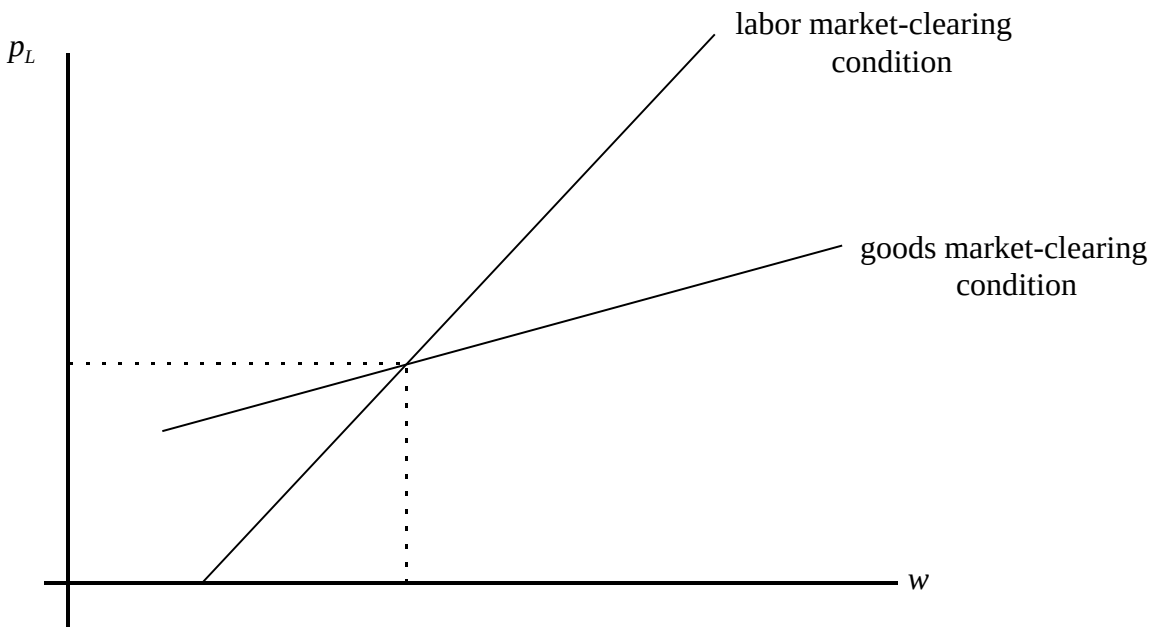

Figure 2: Determination of equilibrium wage and price of low-quality goods

Appendix

Proof of Proposition 1. Consider equation (8) first. By convexity of π_H and π_L in w, demand for labor by both high- and low-quality producers falls with w, holding $\bar{z}$ and $\underline{z}$ constant. This effect is reinforced by the impact of w on $\underline{z}$, which is positive by equation (6), thereby reducing labor demand and increasing labor supply. It can also be shown that the effect of w on labor demand through $\bar{z}$ is nonpositive.[20] Next, we ask how p_L must change in order to eliminate the excess supply of labor resulting from an increase in w. We assume that labor demand of low-quality producers increases with the price of their output, i.e., that the cross-partial derivative of π_L with respect to w and p_L is negative, in which case demand for labor by low-quality producers rises with p_L, holding $\bar{z}$ and $\underline{z}$ constant. This effect is reinforced by the impact of p_L on $\underline{z}$, which is negative by equation (6), thereby increasing labor demand and reducing labor supply. Finally, the impact of p_L on $\bar{z}$ is positive by equation (5), causing labor demand to decrease (increase) if labor demand of the smallest high-quality producer is larger (smaller) than labor demand of the largest low-quality producer. Even if the impact of p_L on labor demand through $\bar{z}$ is negative, we assume it is dominated by its direct effect and effect through $\underline{z}$, so that the labor market-clearing curve in Figure 2 slopes upward.[21]

Turning to equation (9), we see that the direct effect of an increase in w is to decrease the supply of low-quality goods, given our aforementioned assumption that the cross-partial derivative of π_L with respect to w and p_L is negative. This effect is reinforced by an increase in $\underline{z}$ as more agents choose to become workers instead of entrepreneurs. Finally, the impact of an increase in w on $\bar{z}$ is positive (negative) if labor demand of the smallest high-quality producer is larger (smaller) than labor demand of the largest low-quality producer. Even if the impact of w on supply of low-quality goods through $\bar{z}$ is positive, we assume it is dominated by its direct effect and effect through $\underline{z}$.[22] Next, we ask how p_L must change in order to eliminate the excess demand for low-quality goods resulting from an increase in w. An increase in p_L lowers demand directly and by reducing $\hat{z}$ (causing agents to switch consumption from low- to high-quality goods), and increases the supply of low-quality goods by convexity of π_L in p_L. These effects are reinforced by the impacts through $\underline{z}$ and $\bar{z}$, which both work to expand entrepreneurship in low-quality production and therefore increase the supply of low-quality goods. We thus see that the goods market-clearing curve in Figure 2 slopes upward.

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[20]The effect of w on labor demand through $\bar{z}$ equals $[\partial\Pi_H(\bar{z})/\partial w - \partial\Pi_L(\bar{z})/\partial w](d\bar{z}/dw)$. Rewriting equation (5) as $\Pi_H(\bar{z}, w) = \Pi_L(\bar{z}, p_L, w)$, we have (holding p_L constant) $d\bar{z}/dw = (\pi_L - \pi_H)/[\partial\Pi_H(\bar{z})/\partial w - \partial\Pi_L(\bar{z})/\partial w]$. Since $\pi_L - \pi_H < 0$, the result follows.

[21]We can always ensure this is true by keeping the difference between labor demand of the smallest high-quality producer and labor demand of the largest low-quality producer sufficiently small. This is the sufficient condition stated in the proposition.

[22]Again, the sufficient condition in the proposition ensures this.

The discussion of an increase in p_H in the text proves that, for the case $\sigma = \infty$, the goods market-clearing curve must intersect the labor market-clearing curve from above, if the two curves intersect. Moreover, as σ falls, it is clear from equations (8) and (9) that the goods market-clearing curve must become flatter whereas the slope of the labor market-clearing curve is unchanged. It follows that the goods market-clearing curve is flatter than the labor market-clearing curve. This flatter slope ensures that an equilibrium will be unique if it exists. To establish existence, it is then sufficient to show that for the wage at which the labor market-clearing curve touches the horizontal axis, the value of p_L on the goods market-clearing curve is positive. This is true because a strictly positive wage means that the supply of low-quality goods can be made arbitrarily small by reducing p_L, and must therefore fall below demand for low-quality goods by workers for some $p_L > 0$.■

Proof of Proposition 3:

A decrease in C_H has a direct negative effect on $\bar{z}$, the cutoff talent level for high-quality entrepreneurship. The labor market-clearing curve shifts left due to the direct negative effect on labor demand, which cannot be offset by the impact on labor demand through $\bar{z}$ given the sufficient condition in Proposition 1. The effect on supply of low-quality goods is negative through $\bar{z}$, so the goods market-clearing curve shifts up, making the change in the price of low-quality goods ambiguous and offsetting the decrease in the wage. By dampening any upward shift in the goods market-clearing curve, a sufficiently high price elasticity of demand for the low-quality good ensures that the wage does not rise and that any rise in p_L does not more than offset the fall in C_H in equation (5), so that the cutoff talent level for high-quality entrepreneurship decreases unambiguously. The change in the cutoff talent level for low-quality entrepreneurship is ambiguous but should be small in any case. The change in $\hat{z}$ is also ambiguous.

A decrease in C_L has a direct positive effect on $\bar{z}$, a direct negative effect on $\underline{z}$, and a direct negative effect on $\hat{z}$. The shift in the labor market-clearing curve is ambiguous: it tends to shift left due to the direct negative effect on labor demand, but tends to shift right due to the impacts on labor demand and labor supply through $\underline{z}$. (The impact on labor demand through $\bar{z}$ is small given the sufficient condition in Proposition 1.) The goods market-clearing curve shifts down because the impact on supply of the low-quality good is positive through both $\bar{z}$ and $\underline{z}$, and the impact on demand through $\hat{z}$ is negative. This leaves the net effects on w and p_L ambiguous. We assume the price elasticity of demand for the low-quality good is sufficiently high so that any fall in p_L is too small to offset the direct positive effect on $\bar{z}$ or the direct negative effect on $\underline{z}$. We make the additional assumption that any rise in w is too small to offset the direct negative effect on $\underline{z}$. (The effect of any change in w on $\bar{z}$ is small given the sufficient condition in Proposition 1.) Similarly, we assume that in equation (7) the direct effect dominates any offsetting indirect effects through w and p_L and $\hat{z}$ falls.

A reduction in costs common to starting high- and low-quality producers, such as a decrease in business registration fees, can cause equal decreases in C_H and C_L. This has direct negative effects on $\underline{z}$ and $\hat{z}$. The shift in the labor market-clearing curve is again ambiguous: it

tends to shift left due to the direct negative effect on labor demand, but tends to shift right due to the impacts on labor demand and labor supply through $\underline{z}$. The goods market-clearing curve shifts down because the impact on supply of the low-quality good is positive through $\underline{z}$ and the impact on demand through $\hat{z}$ is negative. This leaves the net effects on w and p_L, and hence the effect on $\bar{z}$, ambiguous. We again assume the price elasticity of demand for the low-quality good is sufficiently high so that any fall in p_L is too small to offset the direct negative effect on $\underline{z}$, and again make the additional assumption that any rise in w is too small to offset the direct negative effect on $\underline{z}$. Finally, we again assume the direct effect dominates in equation (7) and $\hat{z}$ falls.

In the text we show that an increase in p_H unambiguously increases w and p_L, and that $dp_H/p_H > dw/w > dp_L/p_L$, which imply a decrease in $\bar{z}$ and an increase in $\underline{z}$. (These results use the sufficient condition given in Proposition 1.) The fact that p_H and w both increase more than p_L ensures that $\hat{z}$ also rises.■