DEVELOPMENT THROUGH SYNERGISTIC REFORMS

James E. Rauch*
Department of Economics
University of California, San Diego
La Jolla, CA 92093-0508

and

National Bureau of Economic Research
Cambridge, MA 02138

September 2009

For many less developed countries production of high quality output is a precondition for firms to become exporters. Institutional deficiencies that raise costs of high quality production therefore limit the positive impact that trade facilitation can have on income. Consequently, institutional reforms that reduce costs of high quality production and trade reform have synergistic effects. In contrast, institutional reforms that reduce costs of low quality production (e.g., reforms that disproportionately benefit small businesses) interfere with the impact of trade reform. We obtain these results in a heterogeneous firm model that displays standard "industry rationalization" responses to reduced trade costs.

JEL codes: O24, O43
Keywords: development, heterogeneous firms, institutional reform, synergy

* I thank Jennifer Poole for excellent research assistance, an editor and two anonymous referees for helpful comments, and the Institute of Financial Economics at the American University of Beirut for its support. Previous drafts of this paper were presented at the University of Southern California and at a joint IMF/World Bank seminar. I am responsible for any errors.

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. Freund and Bolaky (2008) find that trade does not increase income 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]

[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

Does this mean that, for LDCs, the export market is no different from any other market? No, because success in the developed country export market in particular 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 (2008), 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 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

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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).

[3] This argument is consistent with the results of Levchenko (2007), who finds that countries with strong contract enforcement have a comparative advantage in goods requiring many intermediates in production.

producer looking for a large, greenfield site for its plant. Laeven and Woodruff (2007) 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 interventions that benefit small- and medium-sized enterprises (SMEs), which tend not to be export-oriented and probably tend to produce relatively low quality output. These include institutional and regulatory reforms that reduce distortions and programs that probably add to them, for example by providing technology and marketing support that amount to disguised subsidies (see, e.g., Beyene 2002). Most prominent among the reforms are those that lead to relaxation of credit constraints for SMEs. These become better able to draw entrepreneurial talent from larger, export-oriented, high quality production firms.[4]

My analysis can be seen as aiding the choice between different reforms that alleviate distortions, in the spirit of Hausmann et al. (2008). They write (p. 324), "Policies that work wonders in some places may have weak, unintended, or negative effects in others. … this calls for an approach to reform that is much more contingent on the economic environment…. This understanding can then be used to derive policy priorities accordingly, in a way that uses efficiently the scarce political capital of reformers." My results will show the benefit, when engaged in trade reform, of prioritizing institutional reforms that reduce distortions that harm firms producing export-quality goods over reforms that reduce distortions that harm firms producing low quality goods for the domestic market. Because the tradeoffs involved in the supply of these institutional reforms are indeed more a matter of allocating "political capital" than budgetary resources, they cannot be modeled straightforwardly. I thus follow Hausmann et

[4] Aghion et al. (2007, p. 735) find that "the entry of smallest size firms benefits the most from higher financial development, whereas financial development has either no effect or a negative effect on entry by larger firms."

al. and do not model reform supply, instead concentrating on the impacts of reform implementation.

My argument for synergy (interference) with trade reform of institutional/regulatory reform that supports high (low) quality production does not apply when a country is an exporter of manufactures in general, both low and high quality. It applies best to countries whose producers of low quality goods compete with imports from countries with still lower unskilled wages such as China and India, but whose consumers are still not rich enough to provide a large market for high quality goods. As is noted in Lederman et al. (2009, p. xxii), "Given the rise of China and India, some countries can no longer count on progressing to a higher growth path by exporting manufactured products that are intensive in unskilled, low-cost labor." These are countries whose relatively abundant natural resources keep unskilled wages high. It has often been argued that free trade fails these countries because it allows natural resources to pull labor out of manufacturing, the sector in which employment is alleged to generate positive externalities (see Meier and Rauch 2005, pp. 140-143 for a survey of this and other "Dutch disease" arguments). My reasoning involves no externalities. Instead, trade reform fails to deliver as large a positive impact as expected because of a mismatch between the level of institutional development and comparative advantage in export of high quality manufactures, generated by relatively high unskilled wages and low demand for high quality goods.

In the next two sections of this paper I develop a model that clarifies both the nature of synergy and interference between institutional and trade reforms and the conditions under which they obtain, 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 reform.[5] In section 4 I extend the model to cover foreign direct investment. Conclusions are in section 5.

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, Iacovone and Javorcik 2008). The authors interpret their findings as evidence that firms planning to export to developed countries first invest in raising the quality of their products.[6] 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.[7]

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

[6] Hallak and Sivadasan (2008) argue that there is a quality threshold for exporters and cite numerous studies to support their position.

[7] 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

The standard findings that LDC exporters employ a larger share of nonproduction workers than LDC non-exporters (e.g., Bas 2008, Verhoogen 2008) are consistent with this modeling strategy. We will make the usual identification of nonproduction workers with skilled (educated) workers. We will further assume that production workers for high quality producers are more skilled than for low quality producers. This is widely believed to be true, yet it is surprisingly difficult to find more than anecdotal supporting evidence. Verhoogen (2008, p. 497), for example, reports that a Mexican exporter of automobiles increased employment of more educated relative to less educated production workers in response to quality upgrading.

We will examine synergy and interference with trade reform of four types of institutional reforms: institutional reforms that reduce variable costs of high quality production, fixed costs of high quality production, variable costs of low quality production, and fixed costs of low quality production. In our model, because exporting firms (high quality producers) have higher fixed costs and higher output prices, they will be larger in equilibrium, as is standard in heterogeneous firm models of trade. Hence institutional reforms that only benefit small businesses will be captured in our model by reforms that reduce the costs of low quality production. Below we use examples of the four types of reforms to motivate our analysis, but we will model their effects on costs in reduced form because we are interested in their general equilibrium impacts rather than in the mechanics of how they lower fixed or variable costs.

In the introduction we stressed the importance of contract enforcement for high quality relative to low quality production. Antràs (2005) has an elegant model showing how lack of contract enforcement yields a Hicks-neutral upward shift in the variable costs of a firm that requires high quality inputs. He demonstrates that when the firm and its supplier must make

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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.

relationship-specific investments in the quality of the inputs they provide but cannot contract on that quality, suboptimal investments and higher variable costs result. Antràs models the inability to enforce contracts as resulting when the firm and its supplier are located in different countries, but here we think of this problem as arising between the firm and its domestic suppliers because of poor domestic contract enforcement.

Examples of institutional reforms that lower fixed costs for high quality producers include improved cooperation with foreign regulatory bodies that set and enforce product and process standards, which in turn requires better systems of certification and accreditation for laboratory testing.[8] Stephenson (1997, p. 29) writes, "The lack of capacity at present on the part of many developing countries to carry out the functions of certification and accreditation of laboratory testing is a very revealing fact with serious implications for the objective of trade liberalization and facilitation in the area of standards, since without a system of certification and accreditation for laboratory testing facilities, it is impossible for developing countries to move towards reciprocity in testing results through the elaboration of bilateral or multilateral mutual recognition agreements." Absent mutual recognition, LDC producers that wish to export must incur expenses such as having additional testing done by laboratories acceptable to their foreign buyers. Moreover, neither product nor process certification is a one-off expense. Regarding the ISO 9000 process certification, Nadvi and Wältring (2002, p. 15) state, "Once certified the firm has to undergo regular six-monthly audits, and a re-certification every three years."

The most widely studied reforms that benefit small relative to large firms are those that relax credit constraints.[9] The results of Ayyagari et al. (2007, p. 416) show that "easy access to

[8] Here the distortion that is being alleviated is caused by a network externality.
[9] Beck et al. (2006, p. 939) find, "Small firms report significantly higher financing obstacles than medium firms, and both report higher financing obstacles than large firms." Beck et al. (2004) find that reforms that increase bank competition decrease the extent to which these firms report financing obstacles.

finance (low costs of registering property which makes it easier to put up collateral) and greater information sharing all predict a large SME sector in manufacturing," where "information sharing" is measured by an index derived from the characteristics of credit registries compiled by Djankov et al. (2007). As shown by Manova (2008), easing of credit constraints can be modeled as lowering fixed or variable costs, the latter due to the need to finance working capital. If for working capital we view the materials or output as collateral, the "low costs of registering property that can be used as collateral" would primarily relieve constraints on lending to cover fixed costs. With such a reform already in place, reforms like improving credit registries would disproportionately relieve constraints on lending to cover variable costs. Implicitly, in my model credit-constrained firms turn to informal financing at higher cost, rather than receiving no financing above a threshold.

We will analyze the synergy or interference of these institutional reforms with trade "reform" rather than trade "liberalization." Our objective is to maximize the relevance of our analysis for development strategy looking forward. We are following the shift in the literature on trade promotion for LDCs from concern with tariffs to concern with trade facilitation. For example, *Doing Business* now includes a category of indicators, Trading Across Borders, that measures the time, cost, and number of procedures required to import and export in different countries. This shift in the focus of trade promotion has been driven by the fall in import tariffs for both developed and less developed countries: average import tariffs worldwide dropped from 8.6 to 3.2 percent between 1960 and 1995 (Clemens and Williamson 2002), and for Latin America and the Caribbean most favored nation tariffs fell from an average of more than 40 percent in the mid 1980s to close to 10 percent in the late 1990s (Inter-American Development Bank 2002). Using the Trading Across Borders indicators, Hummels et al. (2007) find that *ad*

valorem tariff equivalents of time delays exceed tariffs in all regions of the world in 2006. Moreover, the scope for reductions in trade costs through policy reform is much greater for LDCs than for developed countries.[10]

The scope for reducing trade costs through reform that improves trade facilitation is good news for countries wishing to benefit from the synergies described here, because these synergies are greater with this type of reform than with trade liberalization through tariff reduction. The intuition is simple. The benefit from tariff reduction is the same as the benefit from equivalent improvements in trade facilitation, minus the loss in tariff revenue. Institutional reform that shifts resources from low to high quality production expands trade, which exacerbates the loss in tariff revenue from trade liberalization, thereby dampening the synergy relative to reforms that cut trade costs without loss of tariff revenue.

For simplicity we consider trade reforms that cut costs of importing but not exporting, e.g., accelerating customs clearance for imports.[11] A reduction in the cost or increase in the speed of importing is crucial for high quality, export-oriented manufacturers because of their dependence on imported intermediates. Bas (2008, Table 6), for example, calculates that during the period 1990-99 imports accounted for 53 percent of the expenditure on inputs by Chilean exporters compared to 11 percent for non-exporters. We assume the trade reforms cut the costs of importing intermediates and final goods equally, with consequences for import-competing producers of the latter that our model must capture if synergy and interference from institutional reforms are to be properly evaluated.

[10] The import delays attributable to customs in less developed regions are typically more than triple as long as in the high income OECD region (Hummels et al. 2007, Table 2-1). Hausman et al. (2005) note that 100 percent of imports coming into Sri Lanka and nearly 100 percent coming into Nigeria are subject to comprehensive inspection, whereas 2 percent are inspected in Germany and only 1 percent in Canada.

[11] If the cost of exporting were reduced as well, this would just reinforce our synergy results.

The heterogeneous firm model we 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. We will adopt the competitive market structure of Lucas rather than the monopolistically competitive market structure of Manasse and Turrini and of Yeaple. [12] 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 mass N_S of skilled (educated) agents and a mass N_U of unskilled agents. Every agent is endowed with one unit of time that he supplies inelastically and with entrepreneurial talent z drawn from a fixed distribution F: $\mathbb{R}^+ \rightarrow [0,1]$, as in Lucas (1978). We also follow Lucas in assuming that entrepreneurial talent is irrelevant for employees (workers are homogeneous). Only skilled agents can become entrepreneurs, as in Rauch (1991), so the distribution of entrepreneurial talent among unskilled agents is irrelevant as well.[13] Each skilled agent has a choice of three careers: (1) he can become an employee and earn the prevailing skilled wage w_S; (2) he can found and manage a firm that produces low quality manufactures; or (3) he can found and manage a firm that produces high quality manufactures. Unskilled agents, on the other hand, can only become employees and earn the unskilled wage w_U.

[12] The competitive market structure greatly simplifies the analysis of the impact of trade and institutional reforms on real aggregate consumption in section 3 below. The absence of any distortions or market failures in our model means that there is no policy motivation for trade taxes or subsidies.

[13] This assumption is strongly supported by the evidence presented in La Porta and Shleifer (forthcoming), who find that education is the most important characteristic distinguishing managers of formal sector firms from managers of informal sector firms.

Although the manufactured good is vertically differentiated into high and low quality, it is not horizontally differentiated,[14] in keeping with the competitive market structure of our model. We can then employ a small open economy assumption to determine the prices of the high and low quality final goods as well as the price of the imported intermediate used by high quality producers. We let p_H^*, p_L^*, and p_I^* equal the world prices of the high quality final good, low quality final good, and intermediate good, respectively. Domestic prices of the importables are then given by $p_L = \tau_L p_L^*$ and $p_I = \tau_I p_I^*$, where τ_J is the amount of good J that must be shipped from abroad in order for one unit to arrive. Following the discussion above, we assume that trade reform reduces importing costs equally for final and intermediate goods, yielding $d\tau_L = d\tau_I$. To save notation we therefore assume $\tau_L = \tau_I = \tau$ without losing any generality in our comparative static analysis.

In addition to the vertically differentiated manufacture, there is a homogeneous agricultural exportable that we designate as numéraire. We employ the simplification often used in trade models with differentiated products and use production of the homogeneous good to pin down the unskilled wage. That is, we assume that the agricultural good is produced under perfect competition using only unskilled labor with productivity q_A, implying $w_U = q_A$. We can think of the agricultural good as a composite of cash and food crops.

The technology for manufactures is more complicated. An agent with entrepreneurial talent z who chooses to become an entrepreneur producing low quality goods must pay a fixed

[14] Even for high quality goods opportunities for product differentiation by LDCs are limited, because LDC exporters typically do not sell to developed country consumers under their own brand names (Gereffi 1994, 1999). We have in mind instead the case where the marketing of products of LDC exporters to developed country consumers is handled by developed country 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 developed country retailers under their "private labels."

cost $w_S C_L$, using the standard assumption that nonproduction workers are skilled labor, and thereby gain access to the production function

$$Q_L = f_L(z, \ell_U; R_L), \tag{1}$$

where ℓ_U is variable unskilled labor input and f_L is linear homogeneous in z and ℓ_U. As stated above, the production process for low quality goods is intensive in use of unskilled labor relative to the production process for high quality goods, so for simplicity we let unskilled labor be specific to production of low quality goods and (below) let skilled labor be specific to the production of high quality goods.[15] R_L indexes reforms that increase productivity (reduce variable costs) for low quality producers, whereas reforms that reduce fixed costs for low quality producers work through C_L.

The entrepreneur managing the production of low quality output chooses ℓ_U to maximize profits given by $\tau p_L^* Q_L - w_U \ell_U - w_S C_L$. The result can easily be shown to be given by the profit function

$$\Pi_L = z\pi_L(\tau p_L^*, w_U, R_L) - w_S C_L = z\pi_L(p_L, w_U, R_L) - w_S C_L, \tag{2}$$

where the function π_L is decreasing and convex in w_U and linear homogeneous in p_L and w_U.

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

$$Q_H = \min[f_H(z, \ell_S; R_H), I/a], \tag{3}$$

where I is input of the imported intermediate and the notation otherwise follows equation (1). Profit maximization yields the profit function

$$\Pi_H = z\pi_H(w_S; p_H^* - a\tau p_I^*, R_H) - w_S C_H = z\pi_H(w_S; \tilde{p}_H, R_H) - w_S C_H, \tag{4}$$

[15] Our results would not be qualitatively changed if we only assumed that high quality production was more intensive in skilled labor than low quality production.

where $\tilde{p}_H \equiv p_H^* - a\tau p_I^*$ and the function π_H has the properties of the function π_L, *mutatis mutandis*. We assume that $\pi_H > \pi_L$, yielding greater scope to entrepreneurial talent in high quality production.[16] We also assume that f_H is Cobb-Douglas in z and ℓ_S. This assumption is not necessary for any of the analysis, but it provides a sufficient condition for the proofs of several results.

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 skilled workers.[17] The cutoff levels of managerial talent, denoted by $\bar{z}$ and $\underline{z}$, are determined by

$$\bar{z}\pi_H(w_S; \tilde{p}_H, R_H) - w_S C_H = \bar{z}\pi_L(p_L, w_U, R_L) - w_S C_L, \tag{5}$$

and

$$\underline{z}\pi_L(p_L, w_U, R_L) - w_S C_L = w_S, \tag{6}$$

respectively. It is clear from Figure 1 that exporting firms will tend to be larger than non-exporting firms measured by value of output (sales). 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.

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

[16] To ensure that this assumption holds, we can reduce π_L relative to π_H by decreasing productivity in low quality goods (e.g., by reducing a shift parameter in f_L).

[17] 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 (2009) 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.

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 our model the manufacture is the vertically differentiated product and the agricultural good is the numéraire. We denote the quantity of agricultural goods consumed by x and the quality of the vertically differentiated manufacture consumed by α. Consumer utility is given by

$$U(x, \alpha) = x\mu(\alpha).$$

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 $p_H (= p_H^*)$. Denoting the consumer's income by y and substituting the budget constraint $y = x + p_L$ or $y = x + p_H$ into the utility function yields

$$u_L = (y - p_L)\mu(\alpha_L) \text{ or } u_H = (y - p_H)\mu(\alpha_H).$$

The condition for the consumer to choose the low-quality good, $u_L > u_H$, then reduces to

$$y < [p_H\mu(\alpha_H) - p_L\mu(\alpha_L)]/[\mu(\alpha_H) - \mu(\alpha_L)].$$

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. Since $\mu(\alpha_H)$ and $\mu(\alpha_L)$ do not enter any other equation in the model, we are free to pick them to ensure that the cutoff income level is above the skilled (and unskilled) wage. 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 $\underline{z} < \hat{z} < \bar{z}$:

$$\hat{z}\pi_L(p_L, w_U, R_L) - w_S C_L = [p_H\mu(\alpha_H) - p_L\mu(\alpha_L)]/[\mu(\alpha_H) - \mu(\alpha_L)]. \quad (7)$$

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 (quantity demanded falls) when their price rises and more

agents consume low quality goods (quantity demanded rises) when the price of high quality goods rises. We also see that $\hat{z}$ is increasing in w_S: as skilled wages rise, entrepreneurs become poorer, causing some to shift from high to low quality consumption. Note that we are free to choose q_A so that $w_U > p_L$ and each unskilled worker is able to purchase one unit of the manufacture, as our specification of vertically differentiated demand requires.[18]

Returning to the supply side of the model, the skilled wage is determined by the need to clear the market for skilled labor. We have

$$-\int_{\bar{z}}^{\infty}(\partial\Pi_H/\partial w_S)dF - \int_{\underline{z}}^{\bar{z}}(\partial\Pi_L/\partial w_S)dF =$$

$$\int_{\bar{z}}^{\infty}[z(-\partial\pi_H/\partial w_S) + C_H]dF + \int_{\underline{z}}^{\bar{z}} C_L dF = \int_0^{\underline{z}} dF, \qquad (8)$$

where we have divided both sides by N_S.

We close the model by determining the quantity (and value) of agricultural exports using the requirement that trade is balanced at world prices. The net value of manufactures imports equals the value of low quality final good imports plus the value of intermediate good imports less the value of high quality final good exports. Denoting agricultural exports by X_A, we have

$$X_A = \tau p_L^*\left(N_U + \left(\int_0^{\hat{z}} dF - \int_{\underline{z}}^{\bar{z}}(\partial\Pi_L/\partial p_L)dF\right)N_S\right) +$$

$$\left(\tau p_I^* a\int_{\bar{z}}^{\infty}(\partial\Pi_H/\partial\tilde{p}_H)dF - p_H^*\left(\int_{\bar{z}}^{\infty}(\partial\Pi_H/\partial\tilde{p}_H)dF - \int_{\hat{z}}^{\infty} dF\right)\right)N_S, \qquad (9)$$

where we have used the facts that $\partial\,\tilde{p}_H/\partial p_I = -a$ and $\partial\,\tilde{p}_H/\partial p_H^* = 1$.

3. Model Solution and Comparative Statics

With w_U determined by agricultural productivity, equations (5) - (8) form a system of four equations in the four unknowns $\bar{z}$, $\underline{z}$, $\hat{z}$, and w_S. With the measure of low quality producers

[18] We can ensure $w_S > w_U$ in equilibrium by, for example, choosing p_H^* high enough (see Proposition 1 below).

determined, employment of unskilled labor in low quality production is also determined, and agricultural production is then determined by employment of the remaining unskilled labor. It follows that by increasing the endowment of unskilled labor N_U we can ensure that $X_A > 0$.

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 the value of w_S. To show that a solution for our model exists and is unique, we therefore need only show that a unique solution exists for w_S. Using the market-clearing condition for skilled labor, I prove this in the Appendix. We thus have:

Proposition 1: There exist unique values of $\bar{z}$, $\underline{z}$, $\hat{z}$, and w_S that satisfy equations (5) - (8), and there exist parameters such that this solution satisfies $w_S > w_U$ and $\underline{z} < \hat{z} < \bar{z}$.

We are now ready to do comparative static analysis. We confirm in the Appendix that trade reform causes entrepreneurs to shift to the more productive technology necessary to enter the export market:

Proposition 2: Trade reform (a decrease in τ) has an "industry rationalization" effect: it causes the least efficient firms to exit ($d\underline{z}/d\tau < 0$) and increases the average productivity of the mix of firms that are present both before and after trade reform ($d\bar{z}/d\tau > 0$).

The impacts of trade reform given in Proposition 2 are the hallmark of heterogeneous firm models (e.g., Melitz 2003).

We now move to our main results, on synergy and interference of reforms. We want to evaluate how the impact of trade reform is affected by institutional reforms. In our model the change in real aggregate consumption in response to any reform equals the change in aggregate consumption of the numéraire (agriculture), because the consumption by every agent of the vertically differentiated good (manufacture) is fixed at one unit. Denoting real aggregate consumption by *RCGNP*, it is easily shown that the impact of trade reform (a decrease in τ) is given by

$$-dRCGNP/d\tau = ap_I^*\left(\int_{\bar{z}}^{\infty}(\partial\Pi_H/\partial\tilde{p}_H)dF\right)N_S + p_L^*\left(N_U + \left(\int_0^{\hat{z}} dF - \int_{\underline{z}}^{\bar{z}}(\partial\Pi_L/\partial p_L)dF\right)N_S\right). \quad (10)$$

This equals the amount of the numéraire saved by reducing the real cost of imports, and reflects the absence of any distortions in our model. We will call the first term the "intermediate goods effect" and the second term the "final goods effect," because they result from reducing the cost of importing intermediate and final goods, respectively. We see that the intermediate goods effect is proportional to the volume of high quality output, so reforms that increase high quality production will enhance this effect. We also see that the final goods effect is proportional to the volume of imports of the low quality good, so reforms that increase consumption or reduce production of low quality manufactures will enhance this effect. We thus expect synergy with trade reform of institutional reforms that make high quality production more profitable and interference with trade reform of institutional reforms that make low quality production more profitable, as we argued in the Introduction. For the most part these expectations are borne out in the results that follow, but there are qualifications due to general equilibrium feedbacks that are not captured by simple intuition. All proofs are in the Appendix.

Our first synergy result is

Proposition 3: Institutional reform that reduces the variable costs of high quality production (an increase in R_H) enhances the impact of trade reform through both the intermediate and final goods effects.

We expect an increase in R_H to augment the impact of trade reform through an increase the volume of high quality output, but it is less obvious that this reform should raise the volume of imports of the low quality good. The intuition is that by raising the skilled wage this reform raises fixed costs and lowers profits for entrepreneurs producing low quality goods, causing some of them to shift their consumption from high to low quality goods, and also pushes some of

these entrepreneurs into wage labor or draws them into high quality production, thereby reducing production of low quality goods.

Our second synergy result is

Proposition 4: Institutional reform that reduces the fixed costs of high quality production (a decrease in C_H) must increase the number of firms producing high quality goods (reduce $\bar{z}$). This leads to an ambiguous effect on the skilled wage w_S. If w_S decreases, this reform must enhance the impact of trade reform through the intermediate goods effect, but leaves the change in the final goods effect ambiguous. If w_S increases, this reform must enhance the impact of trade reform through the final goods effect, but leaves the change in the intermediate goods effect ambiguous.

The ambiguous effect of a decrease in C_H on w_S results because a lower C_H reduces the demand for skilled labor of any firm producing high quality goods while increasing the number of such firms. If w_S falls, more skilled workers become entrepreneurs producing low quality goods and more such entrepreneurs consume high quality output, offsetting the effect of the shift of entrepreneurs from low to high quality production on imports of low quality goods. If w_S rises, output of any firm producing high quality goods falls, offsetting the effect of the shift of entrepreneurs from low to high quality production on total output of high quality goods.

Our first interference result is:

Proposition 5: Institutional reform that reduces the variable costs of low quality production (an increase in R_L) must decrease the number of firms producing high quality goods (raise $\bar{z}$). Higher R_L has an ambiguous effect on the skilled wage w_S. This reform must interfere with the impact of trade reform through the final goods effect. It also interferes with the impact of trade reform through the intermediate goods effect if w_S increases, but leaves the change in the intermediate goods effect ambiguous if w_S decreases.

An increase in R_L raises the output of low quality goods and the incomes of entrepreneurs managing the firms that produce these goods, causing some of them to shift to consumption of high quality goods. Both of these effects decrease imports of low quality goods and therefore interfere with the impact of trade reform through the final goods effect. The decrease in the number of high quality firms caused by the increase in R_L should also interfere with the impact of

trade reform through the intermediate goods effect. However, fewer high quality firms implies lower demand for skilled labor, which could cause the skilled wage to fall despite the reduction in supply of skilled workers as some of them shift to entrepreneurship. We cannot rule out the possibility that the higher output per firm caused by a fall in the skilled wage dominates the reduction in the number of firms so that total high quality output increases.

Our second interference result is:

Proposition 6: Institutional reform that reduces the fixed costs of low quality production (a decrease in C_L) must shift skilled labor from wage work to entrepreneurship producing low quality goods (decrease $\underline{z}$), leading to an ambiguous effect on the skilled wage w_S. If w_S increases, this reform must interfere with the impact of trade reform through both the intermediate and final goods effects. If w_S decreases, this reform leaves the change in both effects ambiguous.

Unlike for an increase in R_L, for a decrease in C_L we cannot rule out the possibility that a fall in the skilled wage causes entrepreneurs to shift from low to high quality production instead of in the opposite direction as expected. This makes the changes in both the intermediate and final goods effects of trade reform ambiguous when w_S decreases. If w_S increases, the intuition for interference of a decrease in C_L with both the intermediate and final goods effects is the same as for an increase in R_L.

The overall direction of these results is clear: institutional reforms that benefit high quality production enhance the impact on real aggregate consumption of trade reform whereas institutional reforms that benefit low quality production reduce this impact. Ambiguities arise mainly due to general equilibrium effects of institutional reforms on the skilled wage.

4. Foreign direct investment

We have seen that the number of firms that produce high quality output will be increased by institutional reforms that reduce 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 $N_S[1 - F(\bar{z})]$ to $(1 + m)N_S[1 - F(\bar{z})]$, where $mN_S[1 - F(\bar{z})]$ is the mass of multinational subsidiaries.[19] 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 multinational subsidiaries as an exogenous variable. For example, this mass could be determined by government licensing agreements.

The presence of foreign subsidiaries changes the market-clearing condition for skilled labor, but leaves equations (5) - (7) unchanged since the foreign entrepreneurs do not become low quality producers:

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

It follows that the only direct impact of an increase in the mass of multinational subsidiaries is to increase the demand for skilled labor, thereby unambiguously increasing the skilled wage rate. The results in Proposition 7 then follow immediately from equations (5), (6), and the use of skilled labor by high quality producers:

Proposition 7: An increase in *m* causes output of all high quality producers to decrease, the least productive domestic firms to exit manufacturing, and the least productive 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).

Proposition 7 strongly suggests that foreign direct investment will interfere with rather than enhance the impact of trade reform on real aggregate consumption, since it interferes with the impact of trade reform through the intermediate goods effect and leaves the change in the

[19] At the cost of additional notation, we could substitute any $z > \bar{z}$ for $\bar{z}$ in the expression for the mass of foreign subsidiaries without affecting the analysis.

impact through the final goods effect ambiguous. However, the presence of multinational subsidiaries adds a term to the expression for the impact of trade reform on *RCGNP* given by equation (10). Denoting the new expression by $dRCGNP_m/d\tau$, we have:

$$-dRCGNP_m/d\tau = m\left(\int_{\bar{z}}^{\infty}(\partial\Pi_H/\partial w_S)dF\right)N_S(dw_S/d\tau) + ap_I^*\left(\int_{\bar{z}}^{\infty}(\partial\Pi_H/\partial\tilde{p}_H)dF\right)N_S$$

$$+ p_L^*\left(N_U + \left(\int_0^{\hat{z}} dF - \int_{\underline{z}}^{\bar{z}}(\partial\Pi_L/\partial p_L)dF\right)N_S\right) \qquad (10')$$

The additional term is the first on the right-hand side. It can be explained as follows. Insofar as it affects the skilled wage, trade reform redistributes income between entrepreneurs who manage high quality production and domestic skilled workers. Any redistribution between domestic entrepreneurs and domestic workers nets out of the change in *RCGNP*, but redistribution between multinational subsidiaries and domestic workers does not. The larger is the employment share of these subsidiaries, the larger is the effect of any change in the skilled wage on aggregate domestic consumption. If trade reform increases the skilled wage ($dw_S/d\tau < 0$), then the presence of multinational subsidiaries has increased the impact of trade reform by the amount of their lost profits. An increase in the skilled wage is likely since trade reform increases the number of high quality producers and the demand for skilled labor by each high quality producer, but is not assured since trade reform also increases the supply of skilled labor by discouraging entrepreneurs from managing low quality production (see Proposition 2).

Nevertheless, because FDI displaces and competes with domestic high quality producers, we cannot count on it to substitute for institutional reform in enhancing the impact of trade reform. Such an effect would be more likely if FDI were actually to have the same direct effect

of increasing productivity of these domestic firms as institutional reform. This would require a departure from the simple competitive framework that has facilitated our welfare analysis.[20]

5. Conclusions

I have argued that for many natural resource abundant countries, trade reform fails to deliver as large a positive impact on aggregate consumption as expected because of a mismatch between the level of institutional development and comparative advantage in export of high quality manufactures, the latter generated by relatively high unskilled wages and low demand for high quality goods. Institutional reform that reduces the fixed or variable costs of high quality production tends to enhance the impact of trade reform for these countries, whereas institutional reform that reduces fixed or variable costs of low quality production tends to reduce its impact. My results can be seen as another argument for making reform priorities dependent on the economic environment, as in Hausmann et al. (2008): when engaged in trade reform, institutional/regulatory reforms that reduce distortions that harm firms producing export-quality goods should take priority over reforms that reduce distortions that harm firms producing low quality goods for the domestic market.

In my model trade reform reduces the cost of importing intermediate and final goods. The intermediate goods effect is proportional to the volume of high quality output (which uses imported intermediates), so reforms that increase high quality production will enhance this effect, and the final goods effect is proportional to the volume of imports of the low quality good, so reforms that increase consumption or reduce production of low quality manufactures will enhance this effect. My synergy results were that institutional reform that reduces the

[20] For empirical evidence regarding the conditions under which FDI increases the productivity of domestic firms in LDCs, see Javorcik (2004).

variable costs of high quality production increases both the intermediate and final goods effects of trade reform, and institutional reform that reduces the fixed costs of high quality production must at least increase the intermediate or final goods effect. On the other hand, institutional reform that reduces the variable costs of low quality production must interfere with the impact of trade reform through the final goods effect and possibly also through the intermediate goods effect, and institutional reform that reduces the fixed costs of low quality production reduces both effects if it increases the skilled wage, with ambiguous impacts otherwise. The presence of foreign subsidiaries interferes with the impact of trade reform through the intermediate goods effect (by displacing domestic high quality production) and leaves the change in the impact through the final goods effect ambiguous, but also raises the possibility that trade reform will redistribute income from foreign entrepreneurs to domestic workers.

These level effects of the interaction between trade and institutional reforms were analyzed in a heterogeneous firm model that displays standard "industry rationalization" responses to trade reform. Future research could consider growth effects of the interaction between these reforms. In particular, there is evidence of a positive association between trade reforms and output growth in manufacturing sectors in which a country is a net exporter and that rely more intensively on imported intermediates (Tressel 2008). This suggests that the same association could hold within sectors comparing high to low quality producers, so that institutional reform that benefits the former could have growth synergies with trade reform through the channel of imported intermediates.

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Appendix

Proof of Proposition 1. As explained in the text, a unique solution for w_S implies a unique solution for $\bar{z}$, $\underline{z}$, and $\hat{z}$. Consider equation (8). By convexity of π_H in w_S, demand for skilled labor by producers of high quality goods falls with w_S, holding $\bar{z}$ and $\underline{z}$ constant. This effect is reinforced by the impact of w_S on $\underline{z}$, which is positive by equation (6), thereby reducing skilled labor demand and increasing skilled labor supply. It can also be shown that the effect of w_S on skilled labor demand through $\bar{z}$ is nonpositive.[21] Moreover, because f_H is Cobb-Douglas in z and ℓ_S, it can be shown that increasing w_S reduces skilled labor demand to zero and decreasing w_S increases skilled labor demand without bound, so exactly one value of w_S must exist that solves equation (8).

We next establish that we are free to adjust parameters to ensure $w_S > w_U$. From equations (8) and (5), increasing p_H^* increases labor demand directly and through lowering $\bar{z}$ but leaves labor supply unchanged, thereby increasing w_S. We are free to increase p_H^* since we assume p_H (= p_H^*) > p_L and $\pi_H > \pi_L$. We can also adjust parameters to ensure $\underline{z} < \hat{z} < \bar{z}$. This is clear from equation (7): since $\mu(\alpha_H)$ and $\mu(\alpha_L)$ do not enter any other equation, we can manipulate them to achieve the desired level of $\hat{z}$.■

Proof of Proposition 2. We first establish $d\underline{z}/d\tau < 0$. An increase in τ raises p_L and therefore lowers $\underline{z}$ by equation (6), holding w_S constant. $\underline{z}$ could still increase if w_S increases, but we will establish that an increase in both $\underline{z}$ and w_S leads to a contradiction. Note from equation (8) that an increase in $\underline{z}$ implies both an increase in skilled labor supply and decrease in skilled labor demand from low quality producers. We then show that skilled labor demand by high quality producers cannot increase if w_S rises, establishing the contradiction. Note that $\tilde{p}_H$ decreases with τ. We then see from equation (5) that if w_S rises, $\bar{z}$ must increase, reducing the number of high quality producers. Moreover, because f_H is Cobb-Douglas in z and ℓ_S, it follows that $-\partial^2\Pi_H/\partial w_S\partial\tilde{p}_H > 0$, so demand for skilled labor by each high quality producer must fall.

Now we can establish $d\bar{z}/d\tau > 0$. This result follows from equation (5), holding w_S constant. $\bar{z}$ could still decrease if w_S decreases, but from equation (5) we see that it must decrease more than proportionately to $\tilde{p}_H$ because Π_H is homogeneous of degree one in $\tilde{p}_H$ and w_S. In that case, however, demand for skilled labor by each high-quality producer must rise because $-\partial\Pi_H/\partial w_S$ is homogeneous of degree zero in $\tilde{p}_H$ and w_S. Since lower $\bar{z}$ implies more high quality producers, their total demand for skilled labor must increase, implying a contradiction with the decrease in skilled labor supply and increase in skilled labor demand implied by $d\underline{z}/d\tau < 0$.■

Proof of Proposition 3. First, we establish $d\underline{z}/dR_H > 0$. From equations (8) and (5), R_H increases labor demand directly and through lowering $\bar{z}$ but leaves labor supply unchanged, thereby increasing w_S. It follows from equation (6) that $\underline{z}$ increases. Second, we establish $d\hat{z}/dR_H > 0$. This follows from equation (7) because w_S increases. Third, we establish that

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

$d\bar{z}/dR_H < 0$. Note that if w_S and π_H increase in the same proportion, $\bar{z}$ must fall by equation (5). Because π_H is Cobb-Douglas, it can be shown that this occurs when the increase in w_S is just enough to offset the increase in R_H and hold $\partial\pi_H/\partial w_S$ constant. Thus if the increase in w_S is greater, by equation (8) labor demand falls unless $\bar{z}$ falls. But since $\underline{z}$ increases, labor supply increases by equation (8), so we need a matching increase in labor demand. Finally, if the increase in w_S is smaller, $\bar{z}$ falls by equation (5). Fourth, we establish that $\int_{\bar{z}}^{\infty}(\partial\Pi_H/\partial\tilde{p}_H)dF$ increases. Because π_H is Cobb-Douglas, if w_S increases enough to reduce $\partial\Pi_H/\partial\tilde{p}_H$ despite the increase in R_H, it must also reduce π_H. But then $\bar{z}$ must rise by equation (5), a contradiction.■

Proof of Proposition 4. First, we establish $d\bar{z}/dC_H > 0$. By equation (5), $\bar{z}$ will increase unless w_S decreases, but by equation (8), with C_H higher w_S cannot be lower unless $\bar{z}$ is higher. Also by equation (8), C_H higher and $\bar{z}$ higher are consistent with w_S higher or lower. To establish the remainder of the proposition, consider C_H lower and hence $\bar{z}$ lower. If w_S is lower, $\int_{\bar{z}}^{\infty}(\partial\Pi_H/\partial\tilde{p}_H)dF$ must be higher, but by equation (6) $\underline{z}$ must be lower and by equation (7) $\hat{z}$ must be lower. If w_S is higher, imports of final goods must be higher since $\bar{z}$ is lower and $\underline{z}$ and $\hat{z}$ must be higher, but $\int_{\bar{z}}^{\infty}(\partial\Pi_H/\partial\tilde{p}_H)dF$ may be higher or lower.■

Proof of Proposition 5. First, we establish $d\bar{z}/dR_L > 0$. By equation (5), $\bar{z}$ will not increase only if w_S decreases. By equation (6), if w_S decreases then $\underline{z}$ decreases. By equation (8), a lower or unchanged $\bar{z}$ and a lower w_S increase labor demand whereas a lower $\underline{z}$ decreases labor supply (and increases labor demand), a contradiction. Second, we establish $d\underline{z}/dR_L < 0$. By equation (6), $\underline{z}$ will not decrease only if w_S increases sufficiently, but then by equation (8) labor demand must fall given that $\bar{z}$ increases, and labor supply cannot fall if $\underline{z}$ does not fall, establishing a contradiction. Since labor supply falls but labor demand may decrease, the change in w_S is ambiguous. Third, we establish that $d\hat{z}/dR_L < 0$. Since $d\underline{z}/dR_L < 0$, we know from equation (6) that w_S/π_L is smaller, and it then follows from equation (7) that $\hat{z}$ decreases. Finally, since $\bar{z}$ increases, if w_S increases then $\int_{\bar{z}}^{\infty}(\partial\Pi_H/\partial\tilde{p}_H)dF$ decreases, but if w_S decreases the change in $\int_{\bar{z}}^{\infty}(\partial\Pi_H/\partial\tilde{p}_H)dF$ is ambiguous.■

Proof of Proposition 6. First, we establish $d\underline{z}/dC_L > 0$. By equation (6), $\underline{z}$ increases unless w_S decreases enough to offset the increase in C_L. However, by equation (8) an increase in C_L and a decrease in w_S necessarily imply a decrease in $\bar{z}$ and therefore an increase in labor demand, in which case a decrease in $\underline{z}$ generates a contradiction because it implies lower labor supply. Second, we establish $d\hat{z}/dC_L > 0$. By equation (7), $\hat{z}$ increases unless w_S decreases enough to offset the increase in C_L, but then $\underline{z}$ must also decrease, a contradiction. To establish the remainder of the proposition, consider C_L lower and hence $\underline{z}$ and $\hat{z}$ lower. If w_S is higher, then by equation (5) $\bar{z}$ must be higher and therefore both $\int_{\bar{z}}^{\infty}(\partial\Pi_H/\partial\tilde{p}_H)dF$ and imports of final goods must be lower. If w_S is lower, the change in $\bar{z}$ is ambiguous, making the changes in both $\int_{\bar{z}}^{\infty}(\partial\Pi_H/\partial\tilde{p}_H)dF$ and imports of final goods ambiguous as well.■

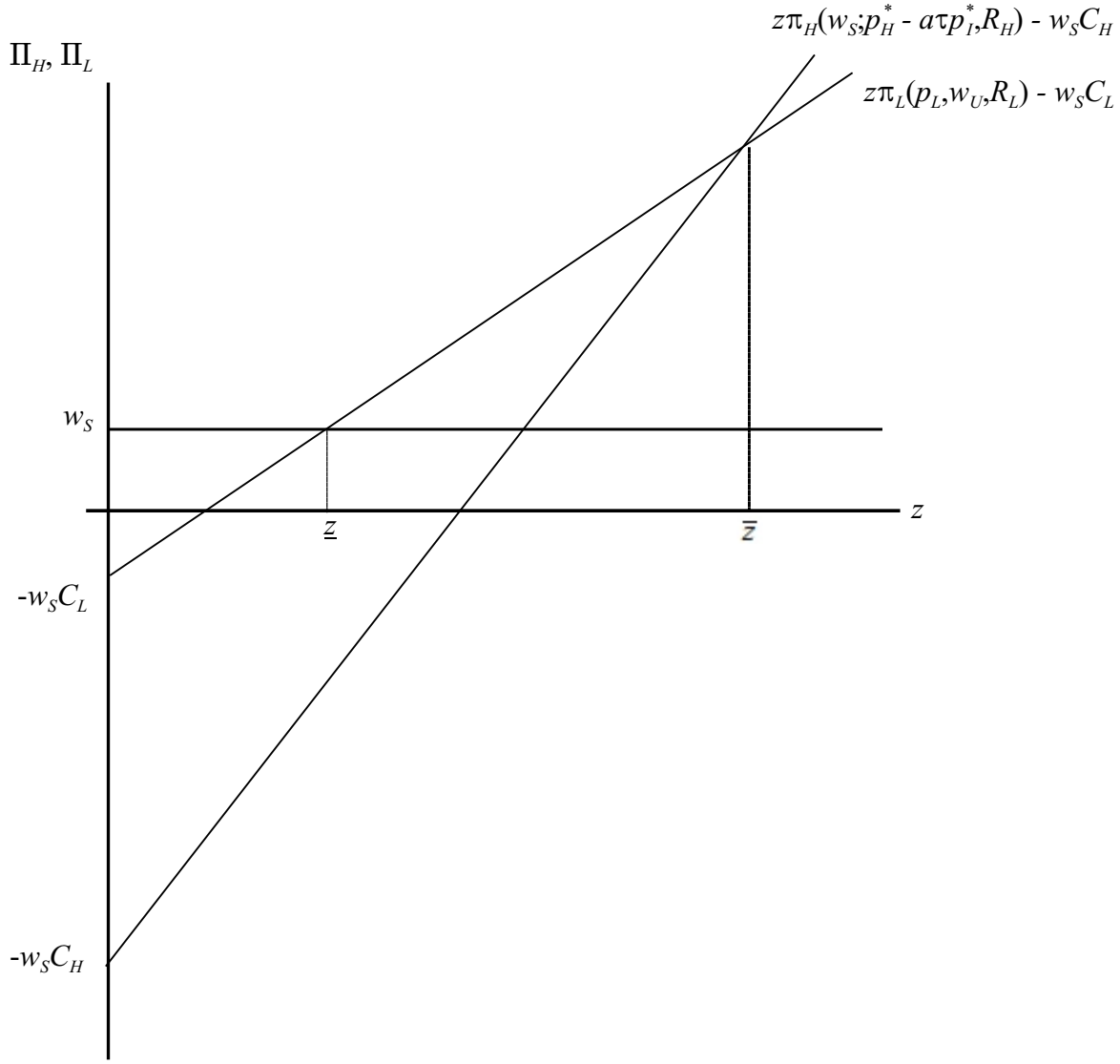

Figure 1: Determination of cutoff levels of entrepreneurial talent