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## Integration, informalization, and income inequality in developing countries: Some general equilibrium explorations in light of accumulating evidence

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# DEPARTMENT OF ECONOMICS

## Working Paper

**Integration, Informalization, and Income Inequality in  
Developing Countries: Some General Equilibrium  
Explorations in Light of Accumulating Evidence**

by

Arslan Razmi

Working Paper 2007-06



**UNIVERSITY OF MASSACHUSETTS  
AMHERST**

# Integration, Informalization, and Income Inequality in Developing Countries: Some General Equilibrium Explorations in Light of Accumulating Evidence

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## Abstract

By focusing on structural features *within* developing economies, this paper attempts to reconcile developments observed in many post-liberalization countries with the help of modified versions of standard trade theory factor endowment models. The common thread generating most of our interesting results is the presence of sectors that are even more labor-intensive than those producing traded goods. Measures undertaken to enhance public sector efficiency and attract investment in an import-intensive export sector may increase rental-wage and skilled-unskilled wage gaps, contra the predictions of the simple Heckscher-Ohlin-Samuelson model. Moreover, increasing income inequality can exist side-by-side with informalization of the economy. The greater unskilled labor-intensity of the informal sector, factor market rigidities in the formal sector, and the sector specificity of some factors crucially influence the outcomes of policy experiments. Even within a simple framework that assumes full employment of resources, large segments of labor may have good reason to fear the consequences of reform.

**JEL Codes:** F16, O17, F11

**Keywords:** Specific factors model, Ricardo-Viner model, Heckscher-Ohlin model, informalization, international production networks, elasticity of factor substitution, nominal wage rigidity, income inequality, skill premium.

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# 1 Introduction and Background

Data from a number of developing countries indicate a trend toward informalization of economies.<sup>1</sup> The growing share of the informal sector at the expense of the formal sector raises serious questions and concerns. Moreover, given the increasing integration of developing countries into world markets the trend towards informalization is perhaps surprising. Such integration has often been accompanied by efforts to limit public spending and investment, to encourage private (foreign and domestic) investment to substitute for it, to enhance external competitiveness by limiting wage growth and/or inflation and through exchange rate targeting, and to provide special incentives for export-oriented production.

Concurrent with the rise of global integration and international production networks has been a rise in income inequality in many developing countries, both in terms of a rising gap between the wages of “skilled” and “unskilled” workers (the “wage-wage” gap or skill premium), and between capital and labor incomes (the “wage-rental” gap).<sup>2</sup> While these outcomes in capital- and skilled-labor abundant developed countries are consistent with the predictions of standard trade theory, the symmetric outcome in skill- and capital-scarce developing countries is not. A growing body of literature recognizes the role that the weakening position of labor unions and the relaxation of labor laws has played in the latter development, making it important to formally incorporate institutional considerations in related trade models.

This paper attempts to construct a partial explanation of these trends with the help of modified versions of the Heckscher-Ohlin-Samuelson (HOS) and Ricardo-Viner specific factors frameworks. The canonical form of these models take commodity prices as exogenously given. Changes in factor prices are then determined by commodity price changes and changes in

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<sup>1</sup>See Blunch *et al.* (2001), Heintz and Pollin (2003), Dev (2000), and Ghose (2003) for a detailed discussion. The share of formal sector employment in total employment is typically quite high in developing countries. For example, Dev (2000) cites a figure for India of 82.1 percent for manufacturing (and 91.1 percent of total employment in all sectors) in 1993-1994. Other countries report somewhat lower figures. For example, Agenor (1996) cites an average figure of more than 70 percent for developing countries. The share of the informal sector in total output can also be quite high. For example, Nagaraj (2004) reports a figure of 40 percent for India.

<sup>2</sup>See, for example, Robbins (1996), Robbins and Gindling (1999), Arbache *et al.* (2004), Beyer *et al.* (1999), Sebastian and Sanguinetti (2003), Audley *et al.* (2004), and Harrison (2002). See Mishra and Kumar (2005) for contrary evidence for India. Cornia *et al.* (2004), World Bank (2007), and Goldberg and Pavcnik (2007) conclude that inequality has gone up in many if not most developing countries. The latter study also provides an excellent survey of the issues involved.

(specific or mobile) factor endowments.<sup>3</sup> Our models, on the other hand, assume internationally determined prices for the traded commodity and internally determined prices for the non-traded and public sector commodities. The idea is to derive possible explanations for increasing informalization and income inequality in the presence of international integration, and in a general equilibrium framework. We do so while attempting to capture more closely the actual conditions that may prevail in the short to medium-run in many developing countries.

The last few decades have brought widespread vertical specialization (or disintegration) in the form of diversified international production networks.<sup>4</sup> Much of this specialization has involved production in export processing zones (EPZs), or other special areas created by governments by providing domestic and international firms sweeping incentives such as tax holidays, reduced tariffs on imported intermediates, suppression of trade union activity, and freedom from the detailed regulations that govern labor markets in the formal sector. As a result, according to UNCTAD (2002, p. 214), the proportion of manufactured exports produced in EPZs is over 95 percent in Mauritius and over 55 percent in Malaysia. In the Dominican Republic, EPZ exports account for over 80 percent of total exports and almost all manufactured exports. EPZ activities are generally concentrated in low value-added, high import intensity traditional manufacturing within vertically-integrated firms.

As mentioned earlier, the informal sector employs a substantial proportion of workers in many developing countries. It can be broadly defined as the relatively less organized and less regulated sector of the economy in which minimum wage laws and other forms of regulation are either completely absent or weakly implemented.<sup>5</sup> Since developing countries generally lack effective employment insurance schemes, being unemployed is a luxury that few can afford. The growth of the informal sector is, in many cases, likely therefore to be a consequence of slow job creation in the formal sector.<sup>6</sup> Moreover, multinational input supply chains and

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<sup>3</sup>The influence of factor endowments on factor prices of course partly distinguishes the specific factors model from the canonical  $2 \times 2 \times 2$  Heckscher-Ohlin model.

<sup>4</sup>This phenomenon is also sometimes called slicing of the value chain, outsourcing, vertical fragmentation, delocalization, and fragmentation.

<sup>5</sup>We avoid here the controversies surrounding the precise definition of the term “informal sector.”

<sup>6</sup>In other words, high unemployment in many developing countries may co-exist with expanding (unregistered) employment in the informal sector. See, for example, Audley *et al.* (2004) and Unni and Raveendran (2007) for the cases of Mexico and India, respectively. See United Nations (2007) for a discussion of the relatively “jobless” growth patterns observed across several developing countries in recent decades.

production-sharing arrangements have significantly re-shaped the nature of the informal sector, large parts of which produce traded goods for international markets, either directly or through transnational corporations (TNCs) searching the globe for “flexible” low cost labor.<sup>7</sup> In many developing countries, a large share of the workforce in key export industries, including textiles, sportswear, garments, and electronics, work in export processing zones or even from their homes under informal employment arrangements.<sup>8</sup> Thus, to the extent that informal production chains increasingly operate in internationally competitive conditions, it is plausible to assume that these respond strongly to international price signals, either directly or through TNC intermediation. In other words, in an increasingly competitive environment, small-scale suppliers operate under conditions approximating perfect competition, and vie for increasing shares of global production networks as price-takers.<sup>9</sup>

Our discussion can be placed in a broader context. The growing income inequality observed in many countries has received significant attention in trade literature. However, existing literature has mainly focused on divergence between skilled and unskilled wages in industrialized countries, and has used the HOS framework as the point of departure. One important finding – that points to technical change as a major culprit behind rising inequality – has been that most of the increased inequality originated from resource shifts *within* industries rather than from shifts *between* them. A related implication is that trade-related Stolper-Samuelson effects have been relatively less important in influencing trends in factor returns.<sup>10</sup> In response, an interesting strand of literature has recently begun to look at the role of vertical disintegration in promoting wage-wage inequality in industrialized countries. Outsourced production of the relatively more unskilled labor-intensive intermediate inputs in developing countries, according to this argument, reduces demand for unskilled labor in industrialized countries via a fall in the relative price of these inputs, leading to a divergence in wages. Relatively little attention

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<sup>7</sup>See for example, Carr and Chen (2002)

<sup>8</sup>See, for instance, Carr and Chen (2002). Rani and Unni (2004) present Indian data that demonstrates a decline in the employment elasticity of output in the formal sector and a simultaneous increase in the informal sector in the late 1990s and early 2000s, attributing the high growth in the informal sector to subcontracting arrangements with firms within and outside the country.

<sup>9</sup>A related consequence is that informal sector workers compete for jobs and wages not only with other informal sector workers in the country, but also with informal sector workers across the globe.

<sup>10</sup>See Berman *et al.* (1994) for example, which is one of the widely cited studies which suggest that most of the increased inequality between skilled and unskilled workers in the US and other countries came from within industry shifts caused by technical changes. The same logic can easily be extended to wage-profit inequality.

has been given, however, to the developing country end of global supply chains.<sup>11</sup>

Davis (1996) suggests an interesting explanation for the contra Stolper-Samuelson results found for many developing countries. A country that is globally labor-abundant may yet be locally capital-abundant relative to other developing countries that have overlapping cones of specialization (i.e., with relatively similar factor endowments). Under certain assumptions, the HOS framework would predict growing wage-rental disparity for such a country. What becomes relevant for determining factor prices, in such a set-up, is a country's mix of factor endowments relative to other countries in its own cone. The paper assumes fully flexible wages and no labor market rigidities. Moreover, it focuses on trade in finished products and on wage-rental gaps.

Marjit (2003) explores the effects of trade liberalization on the informal sector wage in a general equilibrium framework, and finds that the informal wage may increase (and thus wage-wage and wage-rental inequality may decrease) in the presence of an expanding informal sector. The model assumes the use of domestically produced non-traded inputs in export production, which makes it less relevant to the analysis of export sectors which are integrated into international production networks, and which are usually quite intensive in the use of imported intermediate inputs.

In sum, our paper attempts to develop a few plausible explanations for reconciling the following developments observed in many developing countries in recent years:

- greater integration of developing countries into international trade and production networks,
- contraction of employment in the public sector and relatively timid overall employment creation in the formal sector,
- growing wage-wage and wage-rental gaps, and
- increasing informalization of the labor force

Following Marjit (2003), we turn the spotlight on domestic structures *within* developing

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<sup>11</sup>Feenstra and Hanson (1997) develop a model that includes both North and South, but it is set in a long-run Heckscher-Ohlin framework with nationally mobile factors. Moreover, it ignores possible wage rigidity and structural differences between the formal and informal sectors in developing economies, and assumes that all prices are exogenously given. Finally, the study is limited to exploring wage-wage inequality.

economies. The three scenarios that we develop in the following sections assume factor market rigidities and labor market segmentation. The common thread that generates most of our interesting results is the (plausible) presence of sectors in the economy that are *even* more labor-intensive than the traded goods-producing sectors. Given the satisfaction of certain conditions, and assuming that the skilled part of the labor force is employed mainly in the formal sector, our policy experiments yield results that are consistent with the growing wage-wage and wage-rental gaps along with increased informalization of the workforce observed in many developing countries. Moreover, the results are consistent with the kind of within industry shifts mentioned earlier, the shift within the industry in this case being from production under formal arrangements to that under informal arrangements. Most importantly, we demonstrate that increased wage-wage and wage-rental inequality along with informalization may result from:

1. Labor retrenchment in the public sector.
2. The reduction of tariffs on intermediate inputs into a globally integrated export sector.

The intuition behind (1) and (2) can be stated succinctly. Consider first the former. Reduction of employment in the public sector releases labor resources, which get re-employed in the relatively labor-intensive private informal sector, which then expands at the expense of the private formal sector (the Rybczynski effect). The increased availability of labor in the private sector, however, also raises the rental-wage ratio, which has the effect of expanding the relatively less labor-intensive formal sector via factor substitution (the Heckscher-Ohlin effect). The net effect is increasing wage-wage and rental-wage inequality and, if the Rybczynski effect dominates, informalization.

Next consider (2) within a framework that includes traded and non-traded goods. The latter are produced in the informal sector while the former are produced in both the formal and informal sectors, with the traded informal sector assuming the form of an import-intensive export sector (or EPZ) embedded in international production networks. The effect of a reduction in tariffs on intermediates imported into the EPZ is to raise both returns to capital in the EPZ and informal sector wages. The resulting contraction of the formal traded sector puts downward pressure on demand for non-traded goods, and hence on unskilled wages. The overall impact



is likely to be informalization, and, in the presence of sufficiently strong backward linkages between the formal and non-traded sectors, rising wage-wage and rental-wage inequality.

Table 1 defines the symbols employed in the following sections.<sup>12</sup> The next three sections develop the theoretical frameworks and relevant policy experiments. Section 4 concludes.

Table 1: Variable definitions

Variable	Description
$p_j$	Price of sector $j$ good, $j = F, G, I, N, Z$
$a_{ij}$	Unit factor coefficient for factor $i$ in sector $j$ , $i = K, L, S, T, U$
$w$	Returns to labor
$r, R$	Returns to capital
$X_j$	Output of sector $j$
$\bar{L}, \bar{K}, \bar{T}, \bar{S}$	Factor endowments
$\lambda_{ij}$	Fraction of factor $i$ employed in sector $j$
$\theta_{ij}$	Share of factor $i$ in sector $j$
$\sigma_j$	Elasticity of factor substitution in sector $j$
$\delta_{ij}$	Measure of factor $i$ saved due to factor substitution (at unchanged output) in sector $j$

Note:  $\delta_{Kj} = \sigma_j \lambda_{Kj} \frac{\theta_{Lj}}{\theta_{Lj} + \theta_{Kj}}$  and  $\delta_{Lj} = \sigma_j \lambda_{Lj} \frac{\theta_{Kj}}{\theta_{Lj} + \theta_{Kj}}$ .

## 2 Scenario 1: An Economy With a Public Sector, a Formal Sector, and an Informal Sector

Many developing countries have curtailed employment in their public sectors as part of structural reforms in recent years.<sup>13</sup> Moreover, at least some developing (and industrialized) countries have attempted to pursue wage suppression through weakening unions and deregulating labor markets in the formal sector, often with the objective of enhancing international competitiveness through lower production costs.<sup>14</sup>

Consider a small economy which has a significant public sector along with a private sector. The private sector, in turn, consists of formal and informal segments. The public and formal private sectors employ skilled labor while the informal sector mainly employs the less skilled part of the labor force. Skilled workers prefer stable jobs in the formal sector and settle for informal jobs only as a fall back option. The nominal wage in the formal sector, which is assumed to

<sup>12</sup>Most of the notation employed here is well-known from Jones (1965).

<sup>13</sup>See United Nations (2005) for an exploration of the links between public sector retrenchment and informalization in developing economies undergoing structural adjustment.

<sup>14</sup>See UNCTAD (2003) for a discussion of “wage suppression” in recent decades in developing countries.

be equal to that in the public sector but higher than that in the informal sector, is settled through contract negotiations. The wage in the informal sector, on the other hand, is flexible and determined by market conditions (i.e., supply and demand given international commodity prices). The public sector produces a good,  $G$ , which serves as an input (infrastructure, services, utilities, etc.) for the private formal sector, while the formal and informal sectors produce traded goods,  $F$  and  $I$ , respectively, for domestic and international markets. The price of the formal and informal sector goods are therefore, internationally given. The supply of the public sector good is assumed to be inelastic in the short run – reflecting the determination of output through non-market, policy-based considerations – and its pricing is cost-based. The production function is neoclassical, exhibiting constant returns to scale with diminishing returns to individual factors. Due to factor substitutability, the unit factor coefficients are functions of relative factor returns.<sup>15</sup> Commodity and factor markets are perfectly competitive. Capital is assumed to be mobile between the private sectors so that returns are equalized. The informal sector is assumed to be labor-intensive relative to the formal sector.

Price determination can be expressed concisely with the help of the following equations:

$$a_{LG}\bar{w} = p_G \quad (1)$$

$$a_{LF}\bar{w} + a_{KF}r + a_{GF}p_G = p_F \quad (2)$$

$$a_{LI}w + a_{KI}r = p_I \quad (3)$$

The full employment conditions can be expressed as follows:

$$a_{LG}X_G + a_{LF}X_F + a_{LI}X_I = \bar{L} \quad (4)$$

$$a_{KF}X_F + a_{KI}X_I = \bar{K} \quad (5)$$

Finally, the inelastic supply of public sector output implies that:

$$X_G = \bar{X}_G \quad (6)$$

where  $\bar{w}$  is the (negotiated) nominal wage in the public and formal sectors.  $a_{GF}$  is assumed to be fixed for simplicity.

Suppose the public sector pursues efficiency and competitiveness through the retrenchment of “excess” labor. The appendix provides a detailed mathematical treatment. Equations (1)-(3),

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<sup>15</sup>For example,  $a_{iF} = a_{iF}(\bar{w}, r)$ .

determine changes in  $p_G$ ,  $w$ , and  $r$ . Equations (4)-(6) determine the changes in sectoral outputs,  $X_F$  and  $X_I$ . The structure of the model dictates that factor returns are independent of factor endowments.<sup>16</sup> The reduction in public sector employment achieves the objective of making the public sector more efficient (i.e., it lowers costs of production), creating temporary rents in the formal sector, the effect of which is to raise the returns to capital in both private sectors. With internationally given commodity prices, the informal sector wage must fall, increasing both  $r-w$  and  $\bar{w}-w$  inequality. Moreover,  $r-\bar{w}$  inequality rises as well. The effect of the higher rental-wage ratio in both private sectors is to cause substitution in production towards labor. This effect, which we call the “Heckscher-Ohlin” effect, requires, given the full employment assumption, that the formal sector expand at the expense of the informal sector. The “Rybczynski effect” of the release of labor resources from the public sector, on the other hand, operates to expand the more labor-intensive informal sector. Assuming for simplicity that factor substitution is onerous in the formal sector (due to labor regulations, prohibitions on firing workers without just cause, the greater cost of retraining skilled workers, etc.),<sup>17</sup> the formal sector shrinks and the informal sector expands, if the following conditions are satisfied, respectively:

$$\frac{\lambda_{LG}}{\lambda_{LI}} > \sigma_I \frac{\theta_{GF}}{|\theta_1|}$$

$$\frac{\lambda_{LG}}{\lambda_{LI}} > \sigma_I \frac{\theta_{GF}}{|\theta_1|} \left[ 1 + \frac{\theta_{LI}|\lambda_1|}{\lambda_{LI}\lambda_{KF}} \right]$$

where  $|\theta_1| = \theta_{KF}\theta_{LI} > 0$  and  $|\lambda_1| = \lambda_{LF}\lambda_{KI} - \lambda_{LI}\lambda_{KF} < 0$ , the latter sign assuming that the informal sector is labor-intensive relative to the formal sector. The condition for informalization following public sector retrenchment can be concisely expressed as:

$$\frac{\lambda_{LG}}{\lambda_{LI}} > \sigma_I \frac{\theta_{GF}}{|\theta_1|} \left[ 1 + \frac{\theta_{LI}|\lambda_1|}{\lambda_{LI}} \right]$$

In other words, the Rybczynski effect dominates if the initial share of the labor force employed in the public sector is large enough to offset the effects of factor substitution in the informal sector.<sup>18</sup>

<sup>16</sup>The framework has a HOS flavor in this sense.

<sup>17</sup>Rani and Unni (2004), for example discusses the difficult nature of factor substitution in the formal or organized sector in India.

<sup>18</sup>Notice that, since the informal sector is relatively labor-intensive, the second condition is very likely to be satisfied if the first one is.

On a related interesting note, wage suppression in the public sector has similar effects on rental-wage and (possibly) wage-wage gaps,<sup>19</sup> but leads to an *expansion* of the formal sector. The intuition is simple. In this case, there is no release of labor resources from the public sector, and hence no Rybczynski effect. The formal sector unambiguously expands.

In sum, labor retrenchment in the public sector leads to: (i) a growing gap between the returns to capital and labor and between the nominal wage in sectors dominated by skilled and unskilled workers, and (ii) if the initial fraction of the workforce employed in the public sector is sufficiently high, informalization of the economy. Wage suppression in the public sector, on the other hand, leads to (i), but not (ii).

### 3 Scenario 2: An Economy With Traded and Non-Traded Sectors

As mentioned earlier, a number of developing countries now have a major presence of EPZs or other special export-oriented zones in their traded goods sectors. Being part of a broader export-led growth strategy, these zones are often integrated into international production networks, and produce manufactured products (such as clothing and apparel, footwear, and consumer durables) which have a heavy imported intermediate content. Moreover, these intermediates are often subjected to minimal tariffs, such tariff concessions being employed to attract foreign and domestic investment in the export sector. Firms in the EPZs often have relatively weak backward linkages to the rest of the economy, and act as “enclaves” of production for export. Labor regulations are much weaker, and unions prohibited as an incentive for firms.<sup>20</sup>

Our next two policy experiments focus on the effects of tariff concessions for EPZs under alternative scenarios.<sup>21</sup>

<sup>19</sup>It can be shown that:  $\hat{w} = \frac{\bar{w}}{w} \frac{\alpha_{LF}\alpha_{KL}}{\alpha_{LI}\alpha_{KF}} \hat{w}$ . Thus, the higher the initial  $\bar{w}$ - $w$  gap, the higher the likelihood that the  $\bar{w}$ - $w$  gap will increase (i.e., the higher the likelihood that  $w$  will fall more than proportionately relative to  $\bar{w}$ ). The effect of wage suppression on the skill premium is, therefore, path dependent. See the Appendix for a more detailed mathematical treatment.

<sup>20</sup>See United Nations (2005) for a discussion of the role of informal employment in multinational production networks and EPZs.

<sup>21</sup>Note that we use the term “EPZ” here in a generic sense for an import-intensive export-oriented sector.

### 3.1 When Factor Substitution is Limited to the Traded Sectors

Consider a stylized developing economy consisting of a traded goods producing sector and a non-traded goods producing sector. The traded sector, in turn, consists of a formal/organized sector,  $F$ , and an EPZ,  $Z$ . The formal sector mostly employs skilled workers at contracted wages that are higher than those in the EPZ. The latter hires mostly unskilled workers who, in the absence of unions or contracts, work in an informal setting with flexible wages. The non-traded sector, which uses labor only, acts as an alternative employment option for the unskilled portion of the labor force. The same assumptions are made about the production function as in Section 2. While the formal sector uses domestic intermediates, the EPZ uses imported intermediates, both in fixed proportions. Factor supplies are assumed to be given, as are the prices of the traded goods. The price of the non-traded good, on the other hand, is determined by demand conditions in the formal sector. Capital has the option of moving between the two traded goods producing sectors, but, due to the different nature of their output, not between the non-traded and traded sectors.

Production takes place under perfectly competitive conditions.

$$a_{LF}\bar{w} + a_{KF}R + a_{NF}p_N = p_F \quad (7)$$

$$a_{LZ}w + a_{KZ}R + a_{MZ}p_M = p_Z \quad (8)$$

$$a_{LN}w = p_N \quad (9)$$

Full employment implies the following conditions:

$$a_{KF}X_F + a_{KZ}X_Z = \bar{K} \quad (10)$$

$$a_{LF}X_F + a_{LZ}X_Z + a_{LN}X_N = \bar{L} \quad (11)$$

The zero excess demand condition for the non-traded sector can be expressed as follows:

$$ED(X_N) = X_N^d - X_N^s = 0 \quad (12)$$

where  $X_N^d$  and  $X_N^s$  denote the demand for and supply of non-trade goods, respectively. The competitive commodity market conditions yield solutions for the factor prices and  $p_N$ . The

two full employment conditions in combination with the zero excess demand condition for the non-traded good determine sectoral outputs.

Now consider the consequences of concessions for the EPZ in the form of lower import tariffs. A lower intermediate input price translates into higher returns to capital in the EPZ, leading to capital inflows from the formal sector. To understand the change in sectoral outputs, consider first the effect on factor incomes. The decline in  $p_M$  puts upward pressure on both EPZ returns to capital and the informal sector wage. However, the resulting contractionary pressure on formal sector output puts downward pressure on the price of non-tradables. It can be shown that if backward linkages between the formal sector and the non-tradable sector are sufficiently strong,<sup>22</sup> then the returns to capital in the traded sector rise, while the price of non-tradables and informal sector wage decline.

To grasp the effects on sectoral outputs, it is useful to again break these down into two channels: the Heckscher-Ohlin effect of the shift in income towards capital in the traded sector is to expand the more capital-intensive (formal) sector via factor substitution. However, the Rybczynski effect of the release of any labor from the non-traded sector is to expand the EPZ at the cost of the formal sector. It can be demonstrated that as long as  $\lambda_{KZ} > \lambda_{LZ}$ , that is, the fraction of total capital that is employed in the EPZ is greater than the fraction of total labor that is employed in the EPZ, the latter expands at the cost of the formal and non-traded sectors. Considering that the non-traded informal sector typically employs a large proportion of domestic labor in developing countries, this assumption is quite plausible.

In sum, a decline in the imported intermediate price leads, in the presence of strong backward linkages between the formal and domestic non-traded sectors, to: (i) a growing gap between the returns to capital and labor and between the nominal wage in sectors dominated by skilled and unskilled workers, and (ii) if the initial fraction of the workforce that is employed in the EPZ is sufficiently low, informalization of the economy.

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<sup>22</sup>In mathematical terms,  $\frac{\theta_{NF}}{\theta_{KF}} > \frac{\theta_{LZ}}{\theta_{KZ}}$ .

### 3.2 When Factor Substitution Takes Place in All Sectors

Finally, consider another stylized developing economy similar to the one in Section 3.1 with the difference that the informal traded sector employs capital,  $T$ , in addition to labor. We assume, in order to make the analysis tractable, that skilled workers are specific to the formal sector while unskilled labor is specific to the other two sectors. Again, the prices of the traded goods are assumed to be internationally set. The price of the non-traded good, on the other hand, is determined by excess demand conditions.<sup>23</sup> Capital has the option of moving between the two traded goods producing sectors, but, due to the different nature of their output, not between the non-traded and traded sectors.

Production takes place under perfectly competitive conditions.

$$a_{SF}\bar{w}_S + a_{KF}R + p_N a_{NF} = p_F \quad (13)$$

$$a_{UZ}w_U + a_{KZ}R + a_{MZ}p_M = p_Z \quad (14)$$

$$a_{UN}w_U + a_{TN}r = p_N \quad (15)$$

where  $\bar{w}_S$  and  $w_U$  are the skilled and unskilled labor wages. Full employment and zero excess demand for the non-traded good imply the following conditions:

$$a_{SF}X_F = \bar{S} \quad (16)$$

$$a_{TN}X_N = \bar{T} \quad (17)$$

$$a_{KF}X_F + a_{KZ}X_Z = \bar{K} \quad (18)$$

$$ED(X_N) = X_N^d - X_N^s = 0 \quad (19)$$

The competitive commodity market conditions yield three equations in four unknowns,  $R$ ,  $r$ ,  $w_U$ , and  $p_N$ . The three full employment conditions determine sectoral outputs, which in combination with the zero excess demand condition for the non-traded good and the competitive market equations yield reduced form solutions for the entire system. Put differently, equation

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<sup>23</sup>Note that, due to factor substitution, the supply of the non-traded good changes directly with price, unlike the case in Section 3.1.

(13) determines  $R$  for a given  $P_N$ . Equation (14) then determines  $w_U$ , which in turn determines  $r$  via equation (15). We assume that a unique price level, say  $P_N = P_N^E$ , exists that clears the non-traded market.<sup>24</sup>

Now consider again the consequences of reduced tariffs on EPZ imports. A lower intermediate input price translates into higher returns to capital in the EPZ, leading to capital inflows from the formal sector, which shrinks as a result. The effect on the unskilled wage depends on the change in sectoral outputs and the price of the non-traded good. Again, the detailed algebra has been relegated to the appendix. However, it can be shown that if:

$$\sigma_F \theta_{KF} \theta_{NF} \theta_{UZ} \theta_{TN} + \sigma_N \theta_{UN} (1 - \theta_{NF}) (\theta_{KZ} \theta_{NF} - \theta_{KF} \theta_{UZ}) > 0$$

then the EPZ expands at the expense of the other sectors, and the  $r$ - $w$  gap increases. Also, the return to capital in the non-traded sector declines.<sup>25</sup> Furthermore, if in addition,

$$\frac{\sigma_N}{\sigma_F} > \left( \frac{\theta_{NF}}{1 - \theta_{NF}} \right) / \left( \frac{\theta_{UN}}{1 - \theta_{UN}} \right)$$

then the  $\bar{w}$ - $w$  gaps increases as well. For the first condition to be satisfied, it is *sufficient* that  $(\theta_{NF}/\theta_{KF}) > (\theta_{UZ}/\theta_{KZ})$ , that is, that the formal sector have sufficient backward linkages to the non-traded sector. The second condition requires that factor substitutability in the non-traded sector relative to that in the formal sector be greater than the cost share of the non-traded input in the formal sector relative to that of unskilled labor in the non-traded sector, which is quite plausible (assuming relatively low factor substitutability in the formal sector).

Perhaps the conditions are better explained intuitively. A decline in intermediate input costs leads to temporary rents in the EPZ, putting upward pressure on both returns to traded sector capital and unskilled wages. However, the shrinkage of the formal sector, and the resulting decline in the non-traded commodity's price puts downward pressure on the unskilled wage. The net effect on the latter is ambiguous, and is likely to be negative the higher the intensity of domestic input use in the formal sector.

Assuming zero factor substitutability in the formal sector (for reasons discussed in Section 2) leads to similar results in terms of factor returns and informalization under the condition

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<sup>24</sup>Notice that this framework has a Ricardo-Viner specific factors flavor unlike the previous two frameworks.

<sup>25</sup>Tariff concessions for imported intermediates, therefore, create a conflict of interest between owners of capital in the traded and non-traded sectors.



that  $(\theta_{NF}/\theta_{KF}) > (\theta_{UZ}/\theta_{KZ})$ .<sup>26</sup>

In sum, given the satisfaction of certain conditions, a decline in imported input prices in the EPZ leads to both a growing gap between returns to traded sector capital and labor and between skilled and unskilled wages, in addition to resulting in informalization of the economy.

## 4 Concluding Remarks

We have attempted to contribute to reconciling some developments observed in post-liberalization, post-reform decades in many developing countries. In particular, we have developed plausible scenarios in which growing wage-wage and wage-rental disparities can co-exist with informalization and/or retarded formal sector job creation following measures to attract export-oriented investment and to make the public sector more efficient. We demonstrate, with the help of three relatively simple frameworks, that such measures can contribute to informalization, in addition to creating conflicts between capital and labor as well as skilled and unskilled labor.<sup>27</sup> The presence of sectors within the economy that are even more labor-intensive than the expanding traded goods-producing sector generates distributional effects that contradict expectations based on the HOS model in its traditional form. Moreover, the greater unskilled labor-intensity of the informal and/or non-traded sectors, factor market rigidities in the formal sector, and the immobility of some factors across sectors play key roles in determining the outcomes. Pre-liberalization expectations may have underestimated some of these factors. Even within simple frameworks that assume full employment of resources, large segments of labor may have reasons to fear the consequences of reform in the absence of adequate compensation schemes.

How generalizable are our frameworks? Diverse experiences are easy to find. Many developing countries have used trade policy as a tool to shift labor resources from subsistence activities in labor-abundant rural areas to more productive activities in (semi-)urban traded goods sectors. Others have seen significant retrenchment in the role of the public sector. Yet others, however, have experienced significant growth in relatively capital-intensive service sec-

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<sup>26</sup>Notice that this is the sufficient condition for getting similar results under the assumption of non-zero factor substitutability in the formal sector.

<sup>27</sup>And indeed, between traded and non-traded sector capitals.

tors.<sup>28</sup> Further exploring the empirical relevance of our hypothesized mechanisms as a (partial) explanation for growing inequality and informalization in parts of the developing world raises interesting possibilities for future research.

## A Appendix

### Scenario 1

Differentiating equations (1)-(3), applying the Envelope Theorem, and solving simultaneously yields:

$$\hat{a}_{LG} + \hat{w} = \hat{p}_G \quad (\text{A.1})$$

$$\theta_{LF}\hat{w} + \theta_{KF}\hat{r} + \theta_{GF}(\hat{a}_{GF} + \hat{p}_G) = \hat{p}_F \quad (\text{A.2})$$

$$\theta_{LI}\hat{w} + \theta_{KI}\hat{r} = \hat{p}_I \quad (\text{A.3})$$

where the circumflexes or “hats” denote percentage changes. Solving equations (A.1)-(A.3) simultaneously yields the following solutions:

$$\hat{p}_G = \frac{\theta_{LI}\theta_{KF}}{|\theta_1|}[\hat{w} + \hat{a}_{LG}] \quad (\text{A.4})$$

$$\hat{r} = \frac{\theta_{LI}}{|\theta_1|}[\hat{p}_F - \theta_{GF}(\hat{a}_{LG} + \hat{a}_{GF}) - (\theta_{LF} + \theta_{GF})\hat{w}] \quad (\text{A.5})$$

$$\hat{w} = \frac{1}{|\theta_1|}[\theta_{KF}\hat{p}_I - \theta_{KI}\hat{p}_F + \theta_{KI}\theta_{GF}(\hat{a}_{LG} + \hat{a}_{GF}) + \theta_{KI}(\theta_{LF} + \theta_{GF})\hat{w}] \quad (\text{A.6})$$

where  $|\theta_1| = \theta_{LI}\theta_{KF} > 0$ . Differentiating equations (4)-(6) and re-arranging yields:

$$\lambda_{LF}\hat{X}_F + \lambda_{LI}\hat{X}_I = \hat{L} - \lambda_{LG}\hat{a}_{LG} + (\delta_{LF} + \delta_{LI})(\hat{w} - \hat{r}) \quad (\text{A.7})$$

$$\lambda_{KF}\hat{X}_F + \lambda_{KI}\hat{X}_I = \hat{K} - (\delta_{KF} + \delta_{KI})(\hat{w} - \hat{r}) \quad (\text{A.8})$$

Solving equations (A.7) and (A.8), and making the appropriate substitutions yields, after considerable manipulation, the solutions in terms of  $\hat{a}_{LG}$ :

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<sup>28</sup>The IT sector in Bangalore and banking and credit in other developing economies come to mind as examples.

$$\hat{X}_F = \frac{\hat{a}_{LG}}{|\lambda_1||\theta_1|} [-\lambda_{LG}\lambda_{KI}|\theta_1| + \{\lambda_{KI}(\delta_{LF} + \delta_{LI}) + \lambda_{LI}(\delta_{KF} + \delta_{KI})\}\theta_{GF}] \quad (\text{A.9})$$

$$\hat{X}_I = \frac{\hat{a}_{LG}}{|\lambda_1||\theta_1|} [\lambda_{LG}\lambda_{KF}|\theta_1| - \{\lambda_{LF}(\delta_{KF} + \delta_{KI}) + \lambda_{KF}(\delta_{LF} + \delta_{LI})\}\theta_{GF}] \quad (\text{A.10})$$

where  $|\lambda_1| = \lambda_{LF}\lambda_{KI} - \lambda_{LI}\lambda_{KF} < 0$ , assuming that the informal sector is labor-intensive relative to the formal sector. Further assuming that labor market regulations and lack of skilled manpower render the elasticity of factor substitution negligibly low in the formal sector yields the following simple condition for the formal sector to contract and the informal sector to expand, respectively, following labor retrenchment in the public sector:

$$\begin{aligned} \frac{\lambda_{LG}}{\lambda_{LI}} &> \sigma_I \frac{\theta_{GF}}{|\theta_1|} \\ \frac{\lambda_{LG}}{\lambda_{LI}} &> \sigma_I \frac{\theta_{GF}}{|\theta_1|} \left[ 1 + \frac{\theta_{LI}|\lambda_1|}{\lambda_{LI}\lambda_{KF}} \right] \end{aligned}$$

Notice that since the informal sector is assumed to be labor-intensive, the second condition is more likely to be met than the first condition. The condition for overall informalization following public sector retrenchment follows from the above two conditions. Mathematically,  $\hat{X}_I - \hat{X}_F > 0$  iff:

$$\frac{\lambda_{LG}}{\lambda_{LI}} > \sigma_I \frac{\theta_{GF}}{|\theta_1|} \left[ 1 + \frac{\theta_{LI}|\lambda_1|}{\lambda_{LI}\lambda_{KF}} \right]$$

Next, solving equations (A.7) and (A.8) in terms of  $\hat{w}$ :

$$\hat{X}_F = \frac{\hat{w}}{|\lambda_1||\theta_1|} [\lambda_{KI}(\delta_{LF} + \delta_{LI}) + \lambda_{LI}(\delta_{KF} + \delta_{KI})] (\theta_{GF} + \theta_{LF}) \quad (\text{A.11})$$

$$\hat{X}_I = -\frac{\hat{w}}{|\lambda_1||\theta_1|} [\lambda_{LF}(\delta_{KF} + \delta_{KI}) + \lambda_{KF}(\delta_{LF} + \delta_{LI})] (\theta_{GF} + \theta_{LF}) \quad (\text{A.12})$$

## Scenario 2a

Differentiating equations (7)-(9) and solving simultaneously in terms of  $P_M$  yields:

$$\hat{R} = -\frac{\theta_{NF}\theta_{MZ}}{|\theta_2|} \hat{P}_M \quad (\text{A.13})$$

$$\hat{w} = \frac{\theta_{KF}\theta_{MZ}}{|\theta_2|}\hat{p}_M \quad (\text{A.14})$$

$$\hat{p}_N = -\frac{\theta_{KF}\theta_{MZ}}{|\theta_2|}\hat{p}_M \quad (\text{A.15})$$

where  $|\theta_2| = \theta_{NF}\theta_{KZ} - \theta_{KF}\theta_{LZ}$ . Next, differentiating equations (10)-(18), and solving simultaneously yields, after substitution from equations (A.13)-(A.15), and manipulation:<sup>29</sup>

$$\hat{X}_F = \hat{X}_N = -\frac{\theta_{MZ}\hat{p}_M}{|\lambda_2||\theta_2|}[\{\lambda_{LZ}(\delta_{KF} + \delta_{KZ}) + \lambda_{KZ}(\delta_{LF} + \delta_{LZ})\}\theta_{NF} + \{\lambda_{LZ}\delta_{KZ} + \lambda_{KZ}\delta_{LZ}\}\theta_{KF}] \quad (\text{A.16})$$

and,

$$\hat{X}_Z = \frac{\theta_{MZ}\hat{p}_M}{|\lambda_2||\theta_2|}[\{(1 - \lambda_{LZ})(\delta_{KF} + \delta_{KZ}) + \lambda_{KF}(\delta_{LF} + \delta_{LZ})\}\theta_{NF} + \{(1 - \lambda_{LZ})\delta_{KZ} + \lambda_{KF}\delta_{LZ}\}\theta_{KF}] \quad (\text{A.17})$$

## Scenario 2b

Differentiating equations (13)-(15) and solving simultaneously in terms of  $P_N$  yields:

$$\hat{R} = -\frac{1}{|\theta_3|}[\theta_{NF}\theta_{UZ}\theta_{TN}]\hat{p}_N \quad (\text{A.18})$$

$$\hat{w}_U = -\frac{\theta_{KF}\theta_{MZ}\theta_{TN}}{|\theta_3|}\hat{p}_M + \frac{\theta_{NF}\theta_{KZ}\theta_{TN}}{|\theta_3|}\hat{p}_N \quad (\text{A.19})$$

$$\hat{r} = -\frac{\theta_{KF}\theta_{MZ}\theta_{UN}}{|\theta_3|}\hat{p}_M + \frac{\theta_{KF}\theta_{UZ} - \theta_{NF}\theta_{KZ}\theta_{UN}}{|\theta_3|}\hat{p}_N \quad (\text{A.20})$$

where  $|\theta_3| = \theta_{KF}\theta_{UZ}\theta_{TN}$ . Next, differentiating equations (16)-(18), and solving simultaneously in terms of  $P_N$  yields, after substitution and manipulation:

$$\hat{X}_F = \frac{\theta_{NF}\theta_{UZ}\theta_{TN}}{|\theta_3|}\frac{\delta_{LF}}{\lambda_{LF}}\hat{p}_N \quad (\text{A.21})$$

$$\hat{X}_Z = \frac{\theta_{TN}}{|\theta_3|\lambda_{KZ}}\left[\delta_{KZ}\theta_{KF}\theta_{MZ}\hat{p}_M - \left(\frac{\delta_{KF}(1 - \theta_{NF}) + \delta_{KZ}(1 - \theta_{MZ})\theta_{LF}}{\theta_{LF}}\right)\theta_{UZ}\theta_{NF}\hat{p}_N\right] \quad (\text{A.22})$$

<sup>29</sup>Note that  $X_N^s = X_N$ , and  $X_N^d = a_{NF}X_F$ .

$$\hat{X}_N = \frac{\delta_{TN}}{|\theta_3|} [\theta_{KF}\theta_{MZ}\hat{p}_M - (\theta_{NF}\theta_{KZ} - \theta_{KF}\theta_{UZ})\hat{p}_N] \quad (\text{A.23})$$

Next, consider equation (19). Since the formal sector uses the non-traded commodity as an intermediate,  $X_N^d = a_{NF}X_F$ . Moreover,  $X_N^s$  simply equals  $X_N$ . Equation (19) therefore yields the reduced form solution for  $p_N$  after the appropriate substitutions:

$$\hat{p}_N = \delta_{TN} \left[ \frac{\theta_{KF}\theta_{MZ}}{\frac{\delta_{LF}}{\lambda_{LF}}\theta_{NF}\theta_{UZ}\theta_{TN} + \delta_{TN}(\theta_{NF}\theta_{KZ} - \theta_{KF}\theta_{UZ})} \right] \hat{p}_M \quad (\text{A.24})$$

Equation (A.24) can now be substituted back into equations (A.18) - (A.23) to derive reduced form solutions for the other endogenous variables.

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