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The Cost of Doing Business in Africa: Evidence from Enterprise Survey Data

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Abstract

Data from the World Bank Enterprise Surveys show that indirect costs (related to infrastructure and services) account for a relatively high share of firms' costs in poor African countries and pose a competitive burden on African firms. We estimate firm-level revenue and value-addded functions for six industries in seventeen developing countries, demonstrating that firm performance is sensitive to the cost of indirect inputs. As indirect inputs are not usually included in estimations of value added, we argue that existing estimates understate the poor relative performance of African manufacturing firms.

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1. Introduction

This paper draws on the World Bank's Enterprise Surveys to better understand some of the factors underlying Africa's slow growth and low levels of economic diversification. We focus on the cost structures of firms, particularly on indirect costs which are relatively small and uniform in advanced countries but important and often overlooked in developing countries. The nature and magnitude of these costs provides suggestive evidence that poor infrastructure and public services present a major barrier to competitiveness for manufacturing firms in poor African countries compared to elsewhere, a barrier that deserves study alongside technology, skills and other subjects of research on the microeconomics of growth and development.

We present data on the cost structures of firms across the developing world, noting that indirect costs, mostly associated with infrastructure-related inputs, account for particularly large shares of firms' costs in poor African countries. High indirect input cost shares in Africa have three possible interpretations: (1) African firms face higher relative prices for indirect inputs, which have limited substitutability for other factors of production; (2) African firms face lower relative prices for indirect inputs, which are highly substitutable for other factors of production; and/or (3) African firms use technologies which are more intensive in indirect inputs on average. Roughly speaking, high indirect cost shares are a burden on firms if (1) is true, and thus (2) is false. In other words, the story is very different depending on whether firms are paying high prices for indirect inputs with relatively inelastic demand or using a lot of indirect inputs because they are cheap. Without input and output price data we cannot directly discriminate between (1) and (2). However, evidence suggests that services are of low quality and that prices are higher

than in other parts of the world (World Bank, 2001- 2007). Therefore, we argue that high indirect cost shares are indicative of a competitive burden placed on African firms by their environments.

In this analysis, we demonstrate how revenue and value-added functions change when indirect inputs are included. We find that the performance of African firms worsens when indirect inputs are built into the analysis. As ignoring indirect inputs is the usual practice in this literature, we argue that existing estimates under-state the poor relative performance of African manufacturing firms. Our explicit emphasis on revenue functions is not new—it has long been recognized that in the absence of price data, revenue functions offer a way to measure firm performance .

We suggest that future research and data collection focus on disentangling the price-quantity issue; the availability of new PPP data (forthcoming) will be useful, but we need firm-level data on output and input prices if we are to understand the relationship between business environments and firm performance.

Section 2 sets out the broad context of the paper. Section 3 discusses some alternative approaches. Section 4 introduces the data. Section 5 highlights patterns in firms' cost structures and discusses alternative interpretations. Section 6 discusses implications for the measurement of firm performance. Section 7 concludes.

2. Costs and Comparative Advantage in Africa.

This section frames our discussion of costs and manufacturing competitiveness in the broader

framework of trade theory. Our basic point is that factor endowments alone cannot explain Africa's poor record on diversification into secondary activities. Rather, their ability to move up the value chain so depends on a broad set of factors which influence firms' costs, including policy actions like the provision of high-quality public services. In light of growth theories that emphasize external economies of scale, Africa's sparseness makes achieving low-cost business environments particularly crucial for achieving a critical mass of investment.

A tradable economic activity is competitive in a given environment if firms can profitably sell at the prevailing world price without subsidies. The classical theory of comparative advantage focuses on the relative abundance (and hence, price) of labor, capital and natural resources as the main determinants of the competitiveness of different economic activities, given that production technologies can be adapted across national boundaries where it is profitable to do so. Wood and Berge (1997) and Wood and Mayer (2001) apply this simple idea to patterns of trade, modeling the relationship between the composition of exports and endowments of skills and land per worker. They find that regions with higher ratios of skills to land export more manufactures relative to primary goods and export a larger proportion of higher-technology manufactures. The corresponding pessimistic view is that Africa's scant human capital and rich natural resource base raises the relative price of labor and dooms the continent to dependence on primary exports.

However, traditional comparative advantage theory misses several crucial points. It cannot explain Africa's low income level, nor its dynamic path of factor accumulation, which has been fraught with financial and human capital flight (Collier et al, 1999). It is difficult to reconcile with the fact that wages are lower in many African countries than in manufacturing powerhouses

like China. It also fails to capture the story of countries which built high-value processing and manufacturing industries around abundant, low-cost natural resource endowments; Australia, Canada, Chile, South Africa and the US are examples. Wright (2000), Wright and Czelusta (2004) and Irwin (2000) all argue that the United States' abundant resource base was a driving factor in its early leadership in processed goods and resource-intensive manufactures. Resource abundance does not doom countries to primary production and stagnation.

Endowments are not deterministic because factor prices also stem from other differences in economic environments. For instance, the quality of infrastructure and public services influences the cost and quality of a range of intermediate inputs. Secondary sectors use inputs like logistics and infrastructure more intensively than agriculture or extractive resource industries (Collier, 2000), so poor infrastructure and public services artificially slant comparative advantage away from secondary activities. This can trap countries in primary production where they otherwise would have the capacity to move into more sophisticated processed products and manufacturing.

Another major source of dynamic competitiveness is external economies of scale generated by agglomeration effects and learning processes in thick markets (Krugman 1980, 1981; Fujita, Krugman and Venables, 1999). The presence of large numbers of suppliers of many intermediate inputs reduces firms' costs, and over time firms may develop cost-reducing technologies as a result of competition and accelerated learning. The effect of external scale economies on economic structure is illustrated by path dependence in the development of individual industries (Burgess and Venables, 2004) as well as by rapid growth in dense regions like China's coast and India's high-tech centers. External scale economies interact closely with the attractiveness of the

business environment: in order to generate a self-reinforcing growth process driven by agglomeration and learning, entry barriers and operating costs must be low enough to attract a critical mass of firms, all the more so where domestic markets are small as in Africa. In this way, comparative (or competitive) advantage is a dynamic, endogenous variable.

How does Africa look in terms of these theories? First, the quality of its infrastructure is poor and most business services are expensive. Transport, power, telecommunications and Internet services are all much more expensive than in other parts of the world; distances between markets exacerbate these costs. For example, Internet costs on average are three times as high as that in Asia (World Economic Forum et al, 2007). Second, its economies are indeed sparse. GDP per square kilometer excluding South Africa is one-tenth the level in Latin America and one-twentieth that in India. Manufacturing value added per hectare is only 1.2 percent that of China. Moreover, the GDP of the median country is barely $3 billion, limiting entry and domestic competition. Without large markets, the attractiveness of business environments and the cost levels facing firms are crucial in attracting sufficient investment to achieve scale economies. Unfortunately, African countries often lag badly on indicators of the quality of the business environment like those from the World Bank's *Doing Business* database.

In the remainder of the paper, we use microeconomic data from enterprise surveys to look more closely at the cost structures of firms in developing countries. We provide evidence that firms in poor African countries, as well as those in poor-performing countries in other regions, face particularly high-cost business environments linked to poor infrastructure and public services. Without substantial reform, such environments are unlikely to attract the critical mass of

investments necessary to push poor-performing countries onto self-reinforcing growth paths.

3. Existing Comparative Research and Methods

Africa's weak growth record has been the subject of an extensive literature in empirical macroeconomics and a smaller, but growing, literature in microeconomics and industrial organization. In the latter, factory-floor productivity and labor costs are common themes, the former due in part to the perception that African firms often use outdated technology, and the latter inspired by classical theories of comparative advantage that suggest that land abundance and labor scarcity in Africa relative to Asia should give rise to relatively high wages in Africa. Labor costs are the focus of several studies, one excellent example is Teal,(1999).

However, previous studies suggest that African wages are in fact very low, and while factory-floor productivity is also in many African countries, it is not low enough relative to wages to explain weak manufacturing performance. For instance, Cadot and Nasir (2001) find that firms in the least productive countries in their study of garment industries, Mozambique and Ghana, have roughly half the factory-floor labor productivity of Chinese firms. However, this gap is more than made up for by lower wages. Garment firms in Madagascar, Kenya, Ghana, Mozambique, and Lesotho have 40-60% lower labor costs per unit of physical output than their counterparts in Chinese export-processing zones; if factory-floor productivity and labor costs are the bottom line, these countries should dominate global markets, but in fact they do not. These findings mirror earlier work by Biggs et al. (1995), which suggests that African firms are well placed to compete on labor costs. Gelb and Tidrick (2000) cite evidence on the cost structures of

African firms in the 1990s, suggesting that labor costs are a relatively small share of total costs (less than 20 percent) and that other types of costs may be more important.

Other literature uses firm-level data to related measures of the quality of the business environment to firm-level "productivity". This literature estimates what are effectively revenue or value-added functions (not production functions; see below for discussion of this distinction) with right-hand-side variables like the number of power outages per month or the percentage of senior management's time spent dealing with regulation. The approach thus relates the business environment to firms' ability to generate output value from a given value of inputs:

[1a] $y_{imc} = f(K_{imc}, L_{imc}, M_{imc}; \mathbf{Z}_{mc}, \boldsymbol{\theta}_{mc}) + a_{imc}$ $\qquad a_{imc} \equiv y_{imc} - f(.)$

[1b] $y_{imc} - M_{imc} = g(K_{imc}, L_{imc}, \mathbf{Z}_{imc}, \boldsymbol{\gamma}_{imc}) + a'_{imc}$ $\qquad a'_{imc} \equiv (y_{imc} - M_{imc}) - g(.)$

Where $y_{imc}, M_{imc}, K_{imc}, L_{imc}$ respectively are the natural logs of sales revenue, raw materials value, capital value and labor for firm *i* in industry *m* in country *c*, $\boldsymbol{\theta}_{ic}, \boldsymbol{\gamma}_{ic}$ are parameters, $\mathbf{Z_c}$ are business environment indicators, and a_{imc}, a'_{imc} are residual terms that picks up variation in input and output prices and firm-level productivity. Equation [1a] is a revenue function and equation [1b] is a value-added function, both of which are common in the literature.

Many analyses of African industry have estimated equations like [1a] and [1b], including World Bank *Investment Climate Assessments* (ICAs) and studies like Biggs, Srivastava and Shah (1995) and Soderbom and Teal (2003). These suggest that skills and human capital shortages, technology gaps and business environment shortcomings like those emphasized in the ICAs and

in the *Doing Business* project may be partly responsible for the poor performance of African firms.

However, omitted variables make it difficult to identify causation. Without country fixed effects, studies find large coefficients (e.g. Bastos and Nasir, 2004). However, African firms have low productivity on average, so any explanatory variable that differs enough on average between African countries and their higher-performing comparators will be significantly correlated with TFP, confounding causal inference. With country fixed effects, coefficients on business environment variables tend to be small and insignificant in these estimations (Dollar, Hallward-Driemeier and Mengistae, 2005). Some important variables like the quality of the main ports and railways are essentially cross-country in nature, making it impossible to distinguish their effects from other country-level unobservables. If the binding constraints on firms vary across countries or regions of countries, the coefficients on individual components of the business environment should vary greatly and non-linearly, further confounding estimation.[i]

Our approach is complementary. We analyze the detailed firm-level financial data contained in the ICS, interested in what can be learned about firms and the environments in which they operate. We focus on types of costs that typically receive little attention but upon inspection are closely linked to business environment factors like infrastructure and public services. We suggest that patterns in these indirect costs may shed light on the impact of such business environment factors on the cost-competitiveness of manufacturing firms.[ii]

4. The Data

Our cross-sectional data[iii] cover seventeen countries in Africa, Asia and Latin America: Eritrea (2002), Ethiopia (2002), Kenya (2003), Nigeria (2000), Senegal (2003), Tanzania (2003), Uganda (2003), and Zambia (2002), and as comparators Bangladesh (2002), Sri Lanka (2004), China (2003), India (2002), Bolivia (2000), El Salvador (2003), Guatemala (2003), Honduras (2003), and Nicaragua (2003).[iv] The data include around 7,000 firms in six industry categories (textiles, garments, and leather; food and beverage processing; metals and machinery; chemicals and paints; wood and furniture; other). Of these firms, around 1,800 are in Sub-Saharan Africa. There is a large spread across firm sizes, although the Africa and Latin America samples contain more small and medium enterprises than the Asia samples. The data are accessible at www.enterprisesurveys.org; detailed information on the sampling methodology is also available on this website.

There is significant heterogeneity among our countries; see Eifert, Gelb and Ramachandran (2005) for a detailed discussion. The Sub-Saharan African countries (hereafter referred to as "African") are smaller and generally poorer and more agrarian. They also tend to have lower investment rates and smaller manufacturing sectors, with very low manufactured exports relative to Asian and Latin American comparators.

There are also important differences among the African countries. The surveys in Ethiopia and Eritrea took place in the aftermath of a damaging conflict which created severe labor shortages in Eritrea and further isolated Ethiopia by closing off its access to Eritrea's ports. Also, state

control of the economy is pervasive in Ethiopia, with a high prevalence of "party-statal" firms and tensions between the government and the Amharic business community. Nigeria also has been subject to considerable instability, and its oil-dominated economy has suffered from extremely poor governance and has not yet seen a major period of opening. These three economies are distinctive enough that we might expect to see unusual patterns in the firm-level data.

In contrast, Kenya, Senegal, Tanzania, Uganda, and Zambia share a recent legacy of wide-ranging policies to open their economies to trade and foreign investment. Of these, only Senegal and Kenya have avoided severe disruption to their established business communities since independence, whether through revolutions and civil conflict (Uganda) or phases of socialist development and widespread nationalization (Tanzania, Zambia). In this group, Senegal, Tanzania, and Uganda might be considered as better-governed,[v] with Kenya suffering from an extended period of very poor governance and Zambia from an extended period of inconsistent reforms and macroeconomic instability.[vi]

5. The Cost Structures of Manufacturing Firms in Developing Countries

This section uses the Enterprise Survey data to illustrate patterns in firms' cost structures which we argue tell an important story about divergent performance in manufacturing. Figure 1 provides a cross-country comparison of firms' cost structures, broken down into labor costs (wages, benefits), capital costs (loan interest, finance charges, rent and depreciation for equipment), raw materials costs (not including energy), and indirect costs (everything else). In

stronger performers like China, India, Nicaragua, Bangladesh, Morocco, and Senegal, indirect costs are less than 15 percent of total costs, around half the level of labor costs. In contrast, indirect costs in most poor African countries account for 20-30 percent of total costs, often dwarfing labor costs.[vii, viii]

The surveys provide varying degrees of detail by country in terms of the breakdown of indirect costs themselves (Table 1). Energy is consistently the largest component, averaging around one-third of the total. Transport tends to follow in the range of 5-15%, land costs cluster at around 5-10%, telecom and security in the range of 2-8%, and water at around 2%. Marketing is often a significant component in more advanced countries (e.g. China, 21%). A range of items fall under the heading "other costs," which typically includes items such as insurance, office supplies, travel costs, accounting and maintenance. This breakdown shows the predominance of costs related to infrastructure and public services: energy, transport, communications, water, and security together account for more than half of indirect costs in African countries.

With the exception of energy, which is commonly treated under the umbrella of raw materials, most of the components of indirect costs are usually not included in empirical work. In some applications this makes sense, but in the present context we find it appropriate to take a broad view of inputs. Firms complete an extensive series of transactions in the process of doing business, from procurement and delivery of inputs to administration and protection of plant and premises to physical production to sale and transport of outputs. Even if services like security, transport and communications do not enter the factory-floor production process, they are vital inputs into the overall scheme by which firms generate revenue, and their effective prices

(adjusted for quality and other relevant factors) matter for the cost-competitiveness of firms.[ix] Indirect inputs like energy, transport, communications, security, accounting and the like are widely thought of as broadly *complementary* to standard factors of production like labor, capital and raw materials.[x]

So what do indirect cost shares tell us? For simplicity, collapse labor, capital and materials into a single input *H*, denote indirect inputs by *I*, and index firms by *i* and countries by *c*. Consider a CES production function over H and I with elasticity of substitution σ, factor intensity parameters α_{cH} and α_{cI}, and input prices p_{icI}, p_{icH}. The indirect cost share and total cost functions for a cost-minimizing firm *i* are given by the following expressions:

$$[2] \qquad w_i = \frac{\alpha_{cI}^{\sigma} p_{icI}^{1-\sigma}}{\alpha_{cI}^{\sigma} p_{icI}^{1-\sigma} + \alpha_{cH}^{\sigma} p_{icH}^{1-\sigma}} \qquad\qquad [3] \qquad C_{ic} / y_{ic} = [\alpha_{cI}^{\sigma} p_{icI}^{1-\sigma} + \alpha_{cH}^{\sigma} p_{icH}^{1-\sigma}]^{1/(1-\sigma)}.$$

From equation [2], three possibilities can give rise to high indirect cost shares: (i) the relative price of indirect inputs p_i in poor African countries is higher on average and $\sigma < 1$; (ii) p_i is lower on average in poor African countries and $\sigma > 1$; (iii) African firms use technologies which are on average more intensive in indirect inputs, e.g. the α_i are higher. Holding the prices of other inputs constant, from equation [3] we see that (i) implies that high indirect cost shares reflect higher average costs for African firms while (ii) implies the opposite. In other words, the story is very different depending on whether firms are paying high prices for indirect inputs with relatively inelastic demand or using a lot of indirect inputs because they are cheap. Similarly, the

effect of natural intensity in indirect inputs α_i – for instance, geographic sparseness which requires lots of transport services – depends on whether indirect inputs are cheap or expensive.

As mentioned earlier, if we observed the prices and qualities of the range of inputs purchased by firms, we could estimate flexible cost functions and discriminate directly between these possibilities. We could then simulate the effects on firms' production costs of changing the price or quality of inputs like energy or transport. Unfortunately we do not have firm-level price data, so we must rely on secondary evidence and economic reasoning to guide us.[xi] From [2] and [3] above, we know that if indirect inputs are relatively and absolutely more expensive than other factors of production in Africa, high indirect cost shares must reflect a competitive burden on African firms generated by weak substitutability of other factors of production for indirect inputs like electricity, transport, telecommunications and similar services.

There is a great deal of evidence which suggests that indirect inputs are higher cost and lower quality in most African countries. For instance, with respect to transport, the new World Bank Global Logistics Indicators Survey finds that the cost of a typical import transaction is nearly $2,000 in Africa, compared to $1,677 in Latin America, $1,130 in East Asia, and $1,277 in South Asia.[xii] At the top of the list are Cameroon ($5,787) and Zambia ($4,616). A typical import transaction also takes 58 days to complete in Africa, compared to 33 days in East Asia (World Bank, 2007). Research on transport costs shows that these are extraordinarily high as well, both due to geography and due to lack of investment and maintenance. Radelet and Sachs (1998) argue that for landlocked countries in Africa, shipping costs are two to three times higher than for coastal countries—a geographical disadvantage compounded by poor quality or non-

existent roads. Buys et al (2006) use spatial network analysis to identify a network of roads connecting all Sub-Saharan African capitals and other cities with populations over 500,000. They simulate the effect of road upgrading to "functioning" levels, and argue that the increase in overland trade would be about $250 billion over 15 years if such a road upgrading could be accomplished. Finally, Limao and Venables (2000) show that poor infrastructure, rather than geography *per se*, is the main problem in Sub-Saharan Africa—their key finding is that "infrastructure accounts for nearly half the transport cost penalty borne by intra-SSA trade" (p.21).

Electricity yields a similar story; while nominal cost in poor African countries is not too much higher than elsewhere, the *quality* of service is much worse, with firms in our data reporting large numbers of power outages a year, which translate into losses in sales average from 3 to 7 percent of total sales. Our data show that firms in Mozambique average of 192 power outages per year, 94 (Eritrea), 80 (Kenya), 78 (Madagascar), 74 (Uganda), 67 (Tanzania), 40 (Zambia) and 29 (Senegal), compared to 20-30 for Nepal, Nicaragua and Honduras, 10-20 for Ecuador, El Salvador and Guatemala and fewer than 10 for Peru, Brazil, Philippines, South Africa, Cambodia and Thailand (World Bank, *Investment Climate Surveys*, 2001-present). As a result, many African firms produce electricity privately at very high cost ($0.40-$0.60 per kWh)—this is ten times the price of electricity from the public grid in some countries. [xiii] A recent survey of firms in Nigeria shows that almost 40 percent of electricity is privately provided via generators at a cost that is three times the cost of electricity from the public grid—5 vs. 15 Naira per kWh (Adenikinju, 2005). An earlier survey showed that firms suffered from an extraordinary burden imposed by erratic, low quality electricity in Nigeria—bills from the power authority NEPA

varied tremendously from month to month (and seemed uncorrelated to actual power use), power outages were plentiful and the private provision of power necessitated the purchase of expensive generators, fuel that was sometimes hard to find, and maintenance of generator equipment which imposed further costs (World Bank, 2001).

With respect to communications, the cost and quality of services have improved dramatically in recent years with the advent of private cellular companies, but internet service remains slow and expensive in many places. New data from the International Telecommunications Union shows that Broadband prices in Africa are substantially higher than world averages—the ITU estimates that the world price is around $77 while the African average is $206 per 100 kbit/s per month (World Economic Forum et al, 2007). The ITU says that African prices for Broadband service are about three times that of Asia; while some North African countries have lower prices, firms in sub-Saharan Africa face high costs of communication. Limited fixed line networks in the region are problematic as well, increased coverage and lower costs depends largely on the spread of wireless technologies (WEF et al, 2007).

It also seems likely that indirect inputs more expensive *relative to other factors of production* in Africa. Firms in our sub-Saharan African sample pay an average annual real wage of $719, compared to $1,447 in East Asia, $1,008 in Latin America, $3,701 in the Middle East and North Africa, and $830 in South Asia.[xiv] According to the Penn World Tables, the average prices of capital goods in Africa in 2004 were broadly similar to other developing regions, with the notable exception of East Asia. [xv]

It is also worth noting that African production technologies are probably exogenously intensive in some types of indirect inputs, especially in transport and security. African countries are very sparse geographically; excluding South Africa, the continent's GDP per km^2 is one-tenth the level in Latin America and one-twentieth that in India, and manufacturing value added per hectare is only 1.2 percent that of China. As a result, firms must ship their inputs and outputs farther on average and cannot take advantage of economies of scale in transport arising from density. Also, law and order is weak in many African countries, and African firms pay higher bribes (as a percentage of sales) and lose a greater fraction of the value of their sales to crime and theft than their counterparts elsewhere (Eifert & Ramachandran [2004]). As a result, African firms' technologies are exogenously intensive in private security services.

Finally, if despite the evidence above the correct explanation for African firms' high indirect cost shares is low effective prices of indirect inputs and resulting intensive use, it must be true that indirect inputs are highly substitutable for other factors of production. Without input price data we cannot directly rule this out. However, it is generally accepted that inputs like transportation, communications and security services are not very substitutable for inputs used on the factory floor (Jones, 2007). The classic study on energy – which accounts for more than a third of indirect costs in our sample – is Berndt and Wood (1975), which finds that electricity is strongly complementary to capital and only weakly substitutable for labor. Empirically speaking, a large share of African manufacturing firms run private electricity generators despite their very high fixed and per unit costs, which suggests that it is difficult to substitute away from the use of electricity in the manufacturing sector.

In sum, while we cannot use our data directly to establish that African firms' high indirect cost shares are indicative of high average cost burdens, economic reasoning combined with the available secondary evidence suggests that this is indeed the right interpretation.

6. Implications for Measuring Firm Performance

The above analysis suggests that we should extend some performance measurement concepts in economics to account for indirect costs. Our purpose here is to highlight the sensitivity of conclusions about firm performance in developing countries to the common exclusion of indirect inputs from "productivity" estimates, and to interpret that sensitivity in light of the role of business environment issues and indirect costs.

Value-added per worker is a common summary statistic for evaluating the performance of a firm or industry. Defining *net value-added (NVA)* as gross sales less raw materials costs and indirect costs, or equivalently as gross value added (GVA) less indirect costs, gives us a slightly broader indicator of firm performance: for instance, a firm might be quite productive on the factory floor but suffer from very high transport costs, decreasing its NVA relative to GVA. Figure 2 compares these two concepts of value added in per-worker terms. In countries with moderate to low indirect costs (Morocco, India, Bangladesh, Nicaragua, Uganda, Senegal, China, Guatemala), the median ratio of NVA : GVA is 0.7 – 0.8. For Kenya, Tanzania, Eritrea, Nigeria, and Honduras, the range is 0.6 – 0.7, suggesting that firms are squeezed by high indirect costs. Even worse are Ethiopian (0.46), Sri Lankan (0.55) and Salvadorian (0.59) firms. Zambian firms

stand at 0.21; productivity measures based on GVA miss their very poor performance. Among African countries, Senegal and Uganda stand out with low indirect costs.

Figure 3 provides a more detailed look at the difference between gross and net value-added by tracking the distributions of the NVA:GVA ratio across firms within China, Kenya, Tanzania and Zambia. The China distribution is heavily right-skewed, with most of the mass of firms between 0.75 – 0.95. The African distributions have a great deal of mass on the left in the 0.30 – 0.60 range, suggesting that many African firms see their ability to produce value beyond the cost of their direct and indirect inputs heavily constrained by the magnitude of the latter. This is seen sharply in the case of Zambia, where the distribution is centered around 0.40.

We now extend the standard analysis of revenue and value-added functions to incorporate the role of indirect costs. Our argument is that conclusions about firm performance in developing countries--as opposed to in advanced countries where infrastructure and public services function well--are quite sensitive to whether or not researchers choose to ignore indirect costs as is usually done. High average indirect input prices in poor African countries will translate into lower estimated residuals for African firms when indirect inputs are included in the revenue function relative to when they are ignored. The purpose of this exercise is to highlight the sensitivity of performance estimates to choice of measurement and inputs; this sensitivity follows from quite simple mechanics.

The obvious way to extend [1a] to incorporate indirect inputs is to include indirect inputs in a flexible revenue function as follows:

[4a] $$y_{imc} = f\left(K_{imc}, L_{imc}, M_{imc}, I_{imc}; \boldsymbol{\alpha}_{mc}\right) + b_{imc} \qquad b_{imc} \equiv y_{imc} - f(.)$$

The interpretation of the residuals of [4] is in terms of a firm's ability to generate revenue from a given value of inputs: we label them NTFV, or *net total factor value*. We label the residuals of the original version [1b] as GTFV, or *gross total factor value*. The distinction between GTFV and NTFV is that the latter measures a firm's ability to generate revenue conditional on a broader set of input values than the former. If African firms pay higher prices for indirect inputs and/or use indirect inputs more intensively in their business practices, omitting indirect inputs from the estimation should increase measured TFV of African firms relative to their comparators, so $\bar{a}_{AFR} - \bar{b}_{AFR} > \bar{a}_{OTHER} - \bar{b}_{OTHER}$, or equivalently $\bar{b}_{OTHER} - \bar{b}_{AFR} > \bar{a}_{OTHER} - \bar{a}_{AFR}$. That is, the gap between NTFV and GTFV should be on average, larger in African countries.

To extend [1b] to incorporate indirect inputs we use net value-added ($y - m - i$):

[4b] $$y_{imc} - M_{imc} = g\left(K_{imc}, L_{imc}; \boldsymbol{\alpha}_{mc}\right) + b'_{imc} \qquad b'_{imc} \equiv y_{imc} - g(.)$$

We estimated [1a], [1b], [4a] and [4b] industry-by-industry using a variety of flexible production functions and techniques, including stochastic frontier methods; the estimates of the GTFV and NTFV projection errors were almost identical for different functional forms We report the GTFV and NTFV estimates from translog value-added functions and Cobb-Douglas sales functions, with the latter serving to restrict the large number of free parameters for the four-input case; the results are completely robust to change of functional form. We construct the country

averages of GTFV and NTFV; our primary interest is in regional differences in the difference between the GTFV and NTFV. For the value-added functions, Figure 4 illustrates the coefficients and their 95% confidence intervals, normalized with respect to China and adjusted for dropped firms in the case of value-added.[xvi]

Relative levels of GTFV reflect differences in average firm-level input and output prices as well as firm-level productivity. Our data is mildly supportive of the notion that GTFV (factory-floor productivity) is lower on average in African countries than elsewhere in the developing world, but this pattern is not strong (Figure 4). Senegal and Morocco are the two countries with the highest average gross TFP. Uganda and Kenya are on par with China, India, and the more productive Latin American countries. Ethiopia comes in at around 0.8 (indexed relative to China), and Eritrea, Tanzania, Zambia and especially Nigeria lag at around 0.7, 0.6, 0.5 and 0.4 respectively. In other regions, relatively poor performers include Bangladesh, Bolivia and Sri Lanka. Recall the interpretation of GTFV: our estimates imply that Ethiopian firms produce 20% less value-added than Chinese firms for given levels of capital and labor.

The more interesting point is the cross-country differences in the difference between gross and net TFV. The gap between African and other firms widens substantially when we move to NTFV (Figure 4), as high indirect costs push down NVA relative to GVA. Kenyan firms which were almost on par with their Chinese counterparts on GTFV fall to 0.6 relative to China. Ethiopia drops from 0.8 to 0.6. Tanzania, Nigeria and Zambia all fall further, particularly Zambia (from 0.5 to 0.2). These African countries have varying performance on GTFV, but they all suffer heavily from high indirect costs, pushing down their performance on the broader benchmark of

NTFV. In contrast, Ugandan and Senegalese firms drop only modestly on NTFV (0.95 to 0.85 and 1.2 to 1.1, respectively) due to their relatively moderate indirect costs (17% and 13% of total costs). The same goes for lower-cost countries like Bangladesh and India.

The basic results for the revenue functions are similar (Figure 5). For all African countries except Senegal, the NTFV estimates generated from equation [7a] are lower than the GTFV estimates generated from [1a] when compared relative to China. In comparison, Indian, Bangladeshi and Honduran firms all do better relative to China on NTFV than GTFV. The differences between the net and gross estimates are smaller than in the value-added regressions as expected; a given difference in revenue mechanically translates into a proportionally larger difference in value-added.[xvii]

The pattern that emerges is as expected: when indirect costs are left out of the estimation of revenue or value-added functions, African firms look substantially more productive then when indirect costs are accounted for either as part of value-added or as a right-hand-side input. Studies which attempt to quantify differences in the average performance of firms across countries need to be cognizant of this. If a firm incurs very high costs for transporting its goods across long distances on poor-quality roads because of the geography and infrastructure quality it has to deal with, this will not be reflected in a performance metric generated from regressions of sales on labor, capital and raw materials. As such, studies which attempt to benchmark the performance of manufacturing firms across countries in the developing world seriously under-estimate the gap between African firms and their comparators elsewhere when they leave indirect inputs aside and focus exclusively on more traditional inputs. One can object that the

purpose of production functions is to obtain estimates of technical productivity, not broader performance, but this is already a lost cause – variation in output and input prices cannot be assumed away, and in all but the tightest single-industry case-studies, production functions are really revenue functions in practice.

7. Conclusion

The main issue raised in this paper is the importance of including the costs of the wider range of firms' inputs in firm-level analysis, costs which appear to be tightly related to the environment in which firms operate, especially to infrastructure and public services. We have argued that the high indirect cost shares observed in firms in poor African countries are reflective of underlying fundamentals (effective prices, geographic realities) which increase the costs of African firms relative to their competitors. This follows from broad evidence that the poor quality of infrastructure and public services in many African countries drives up the effective prices of a range of important, often complementary inputs into production. The magnitudes are important here: the difference between the indirect cost levels faced by comparable Zambian and Chinese firms is almost equivalent to the whole wage bill of the former.

This suggests that usual benchmarks for the average performance of firms across countries or industries should take indirect costs into account. We have shown that the distribution of net value-added per worker in African countries tends to be much lower than the distribution of traditional or gross value-added, and that African firms look substantially worse on estimates of TFP from revenue and value-added functions which include indirect costs.

This analysis is consistent with research by Jones (2007), who argues that that linkages among intermediate inputs which are not easily substitutable for one another are a leading explanation of enormous cross-country income differences. His point is that the full value chains of firms are characterized by much less substitutability among important inputs as economists often assume when thinking about the factory floor alone. It follows that serious deficiencies in the quality or cost of even a subset of the important inputs along that value chain are capable of sharply decreasing the potential productivity of firms.

Our analysis could be much stronger if we observed the input and output prices faced by firms. We strongly encourage future research to move in the direction of tight industry case studies in which differences in input prices and quality can be very directly observed.

Finally, it is worth asking why the business environment is so hostile in many African countries. Money is part of the problem; easing the severe infrastructure constraints identified in the surveys as contributing to high indirect costs requires major investments. But lowering costs also requires efficient maintenance and improvements in the delivery of business services, which this brings in the need to consider the political economy that underlies state performance and capacity. Business environments usually improve slowly, but in Africa these reforms seem to have occurred even more slowly than elsewhere.[xviii] Eifert, Gelb and Ramachandran (2005) discuss issues related to the political economy of reform in Africa, emphasizing the need for transparent benchmarking of country performance on infrastructure and public services and leveling of the playing field between domestic and foreign firms.

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TABLES AND FIGURES

Table 1. Composition of Indirect Costs by Country, % of total *

Category	Ban	Bol	Chi	ElS	Eri	Eth	Gua	Hon	Ind	Ken	Mor	Nic	Nig	Tza	Sen	Sri	Uga	Zam
Energy	21	29		13	10	48	36	24	59	35	51	31	28	52	58	16	22	31
Land rent	11		32	13		6	21	12	4	1	10	6	5	0	2	5	3	2
Transport	6	15	16		4	5			21	16	9		6					
Telecom	2	2			5	1			8	8	3		5					
Royalties	2	2				0			0	1	2			0				1
Water		5			2					2			2					
Security					1	2				7	3							4
Maintenance		4			9								32					
Insurance		2	3															
Marketing		8	21		1								16					
Accounting					2								1					
Other costs	58	32	28	74	66	38	43	64	8	30	22	63	5	48	40	79	75	62

Countries: Bangladesh, Bolivia, China, El Salvador, Eritrea, Ethiopia, Guatemala, Honduras, India, Kenya, Morocco, Nicaragua, Nigeria, Senegal, Sri Lanka, Uganda, Zambia.

* Calculation corresponds to an average weighted by firm size.

Note: The China Enterprise Survey did not separate energy costs from raw materials costs. We use the fact that energy costs were equivalent to 11.4% of non-energy raw materials on average in the 2002 China survey; for each firm we shift 100-(100/114) = 12.7% of total reported raw materials and energy costs into the category of indirect costs.

Figure 1. Cost Structures, Firm-Level Average, by Country

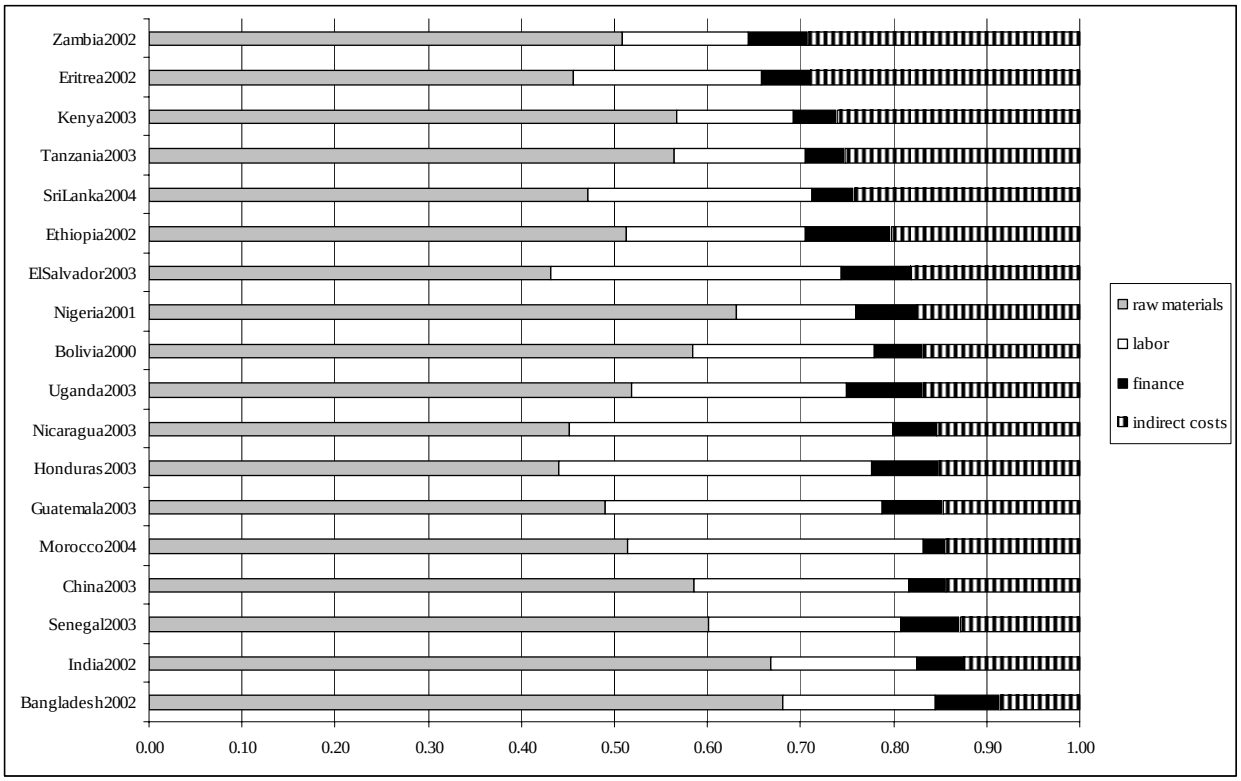
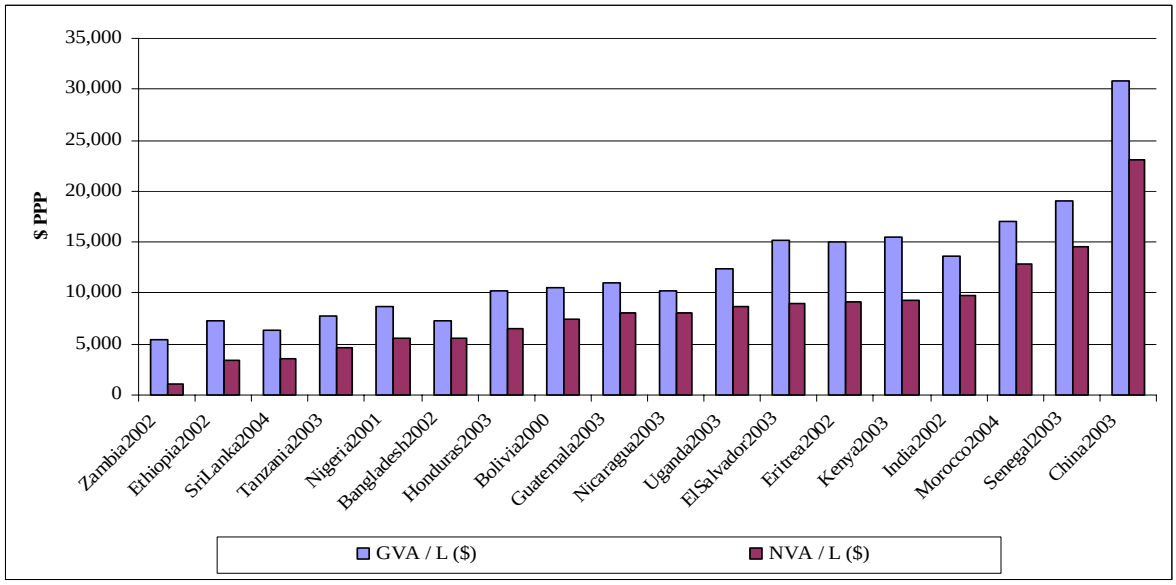


Figure 2. Gross vs. Net Value Added per Worker, $ PPP



Note: All values adjusted by Purchasing Power Parity at the country level and by the relative price of consumption goods versus capital inputs at the regional level (see Appendix Figure 1).

Figure 3. Distribution of Net Value Added / Gross Value Added Ratio

(kernel density estimation)

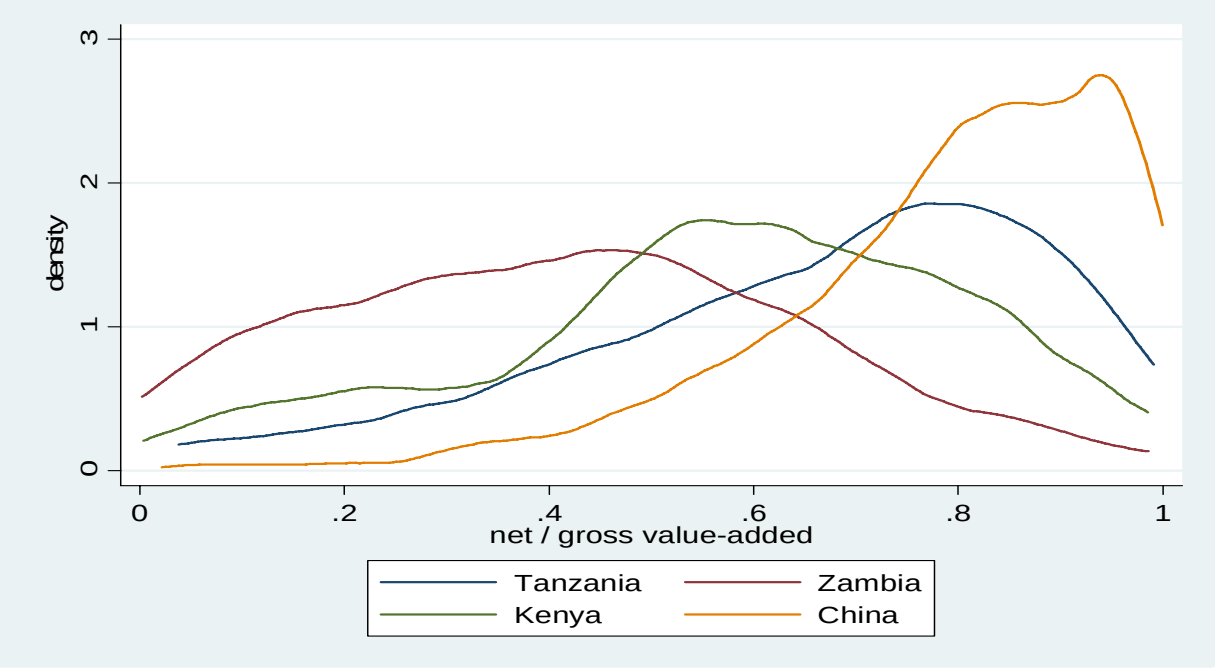
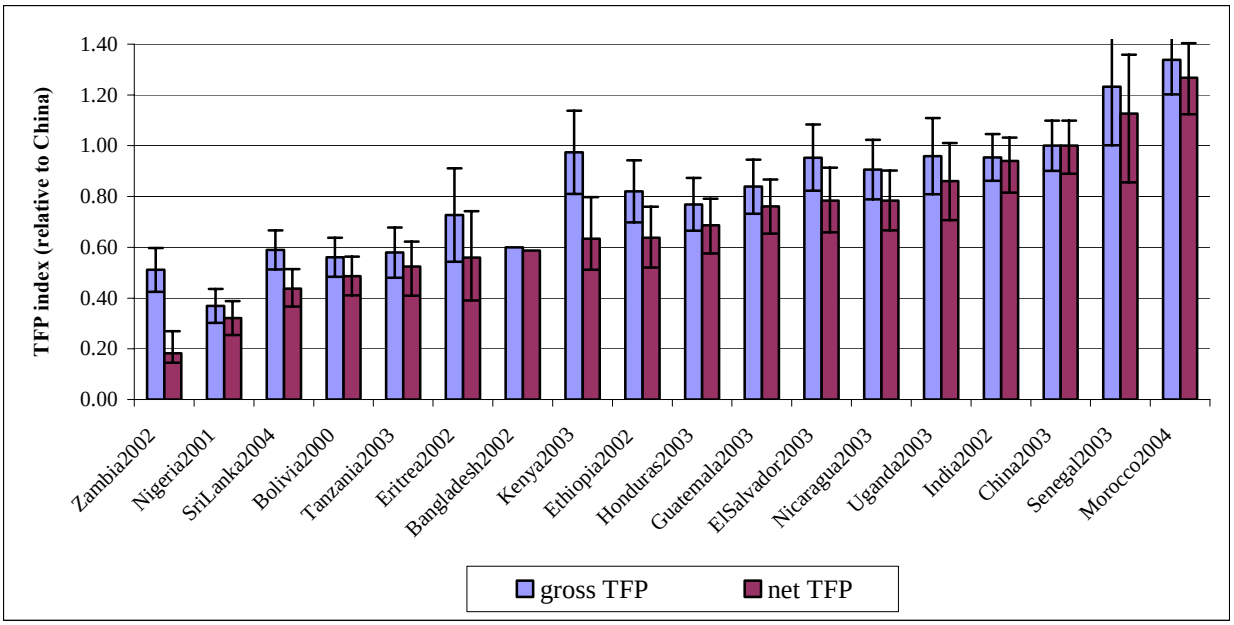


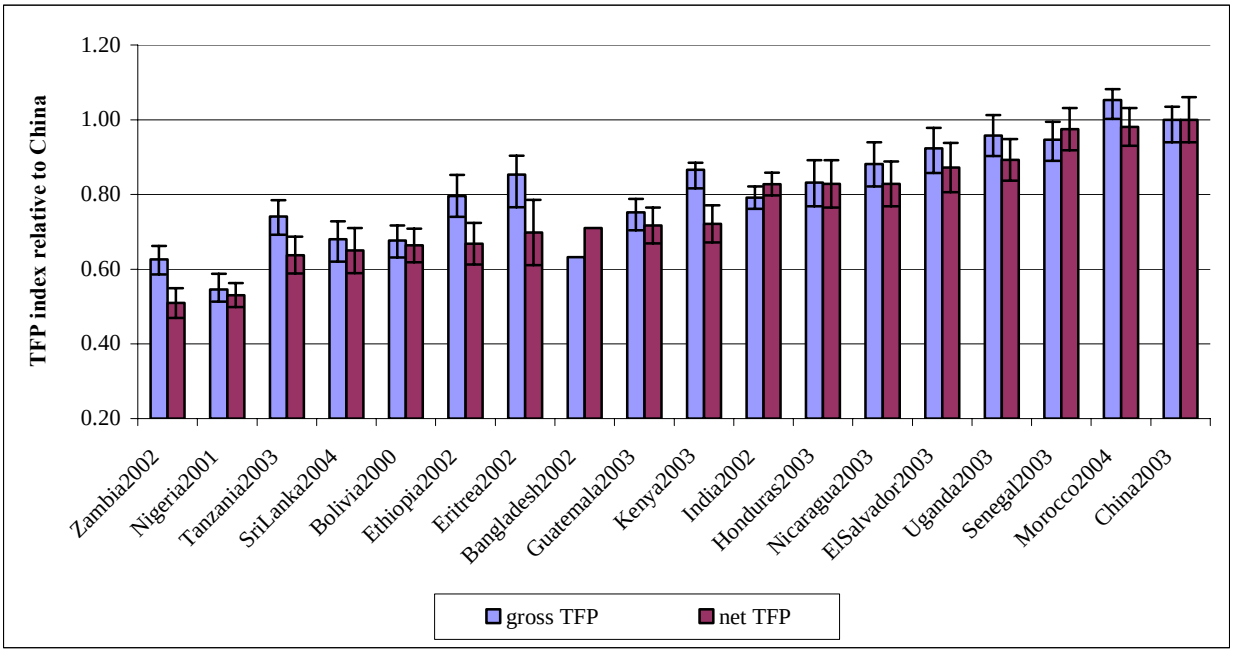
Figure 4. Average Gross vs. Net TFV (OLS, Value-added form), indexed relative to China



Source: Authors' calculations from regression results in Table 5 and dropped firms from Table 4.

*95% confidence intervals represented by black vertical bars.

Figure 5. Average Gross versus Net TFV (OLS, Sales equation), indexed relative to China



Note: 95% confidence intervals indicated by black vertical bars.

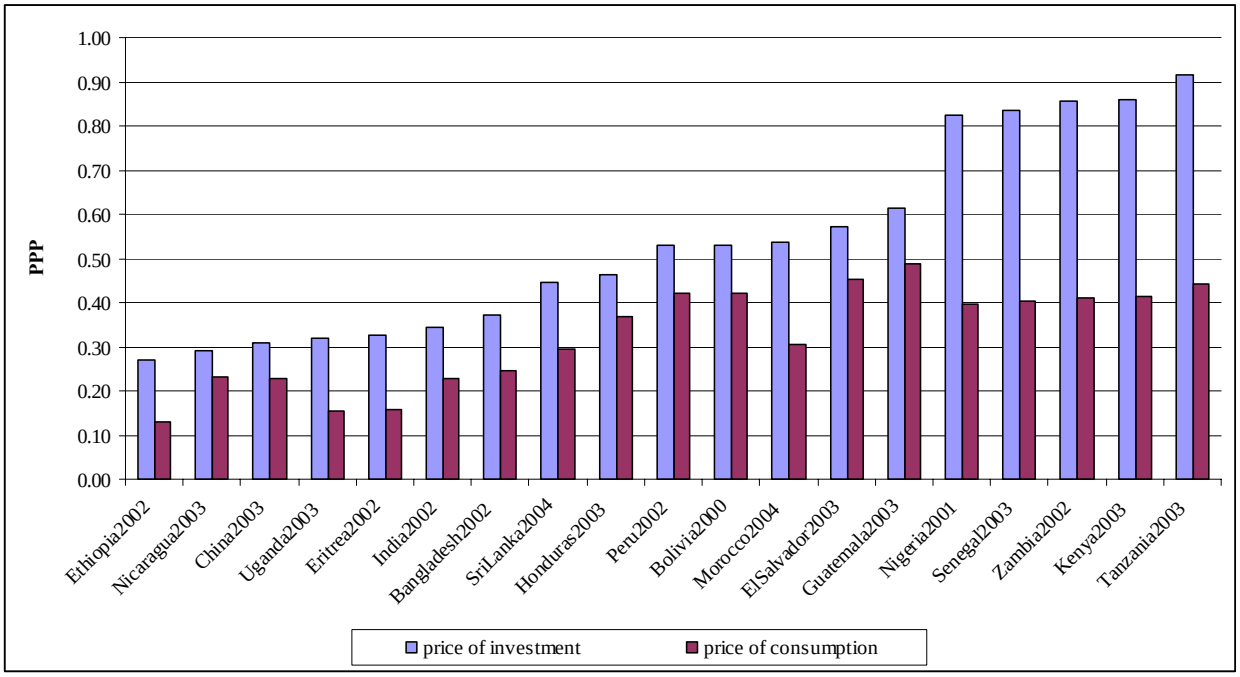
Appendix 1

Table A.1 Summary Statistics for Countries in Study, 2004

Country	Agriculture % GDP	GNI per capita, PPP	INV (% GDP)	FDI (% GDP)	Manufacturing % exports	Mfg Growth %	trade % GDP
Bangladesh	21	1969	24	0.8	90	7.1	36
Bolivia	16	2600	12	1.3	14	5.1	57
China	13	5885	39	2.8	91	..	65
El Salvador	10	4894	16	2.9	60	0.7	71
Eritrea	15	962	22	3.2	11	..	98
Ethiopia	47	750	21	6.8	11	6.7	58
Guatemala	22	4263	18	0.6	42	2.2	49
Honduras	14	2760	29	4.0	27	3.8	91
Kenya	27	1130	18	0.3	21	4.1	58
Morocco	16	4253	25	1.5	69	3.0	72
Nicaragua	19	3481	28	5.5	11	6.6	80
Senegal	17	1662	23	0.9	39	6.5	68
Sri Lanka	18	4208	25	1.2	74	5.1	82
Tanzania	45	671	19	2.3	20	8.0	47
Uganda	32	1448	23	3.3	15	4.0	41
Zambia	21	890	26	6.2	10	5.1	47

Sources: Investment Climate Surveys (capital/worker) and World Development Indicators, World Bank.

Figure A.1 Price Levels for Output (consumption) and Capital Goods (investment)



*Derived from country-level PPP data and adjusted at the regional level for relative price of consumption and investment.

Table A.2. Number of Firms Dropping Out of Value-added Sample with Negative NVA

Country	*GVA > 0*	*NVA > 0*	*% drops*	*Country*	*GVA > 0*	*NVA > 0*	*% drops*
Bangladesh2002	932	922	0.01	Honduras2003	330	309	0.06
China2003	1610	1590	0.01	ElSalvador2003	308	287	0.07
Senegal2003	106	103	0.03	Bolivia2000	340	316	0.07
Morocco2004	798	774	0.03	Tanzania2003	131	117	0.11
Guatemala2003	415	395	0.05	Kenya2003	180	158	0.12
Uganda2003	217	206	0.05	SriLanka2004	296	255	0.14
Nicaragua2003	402	381	0.05	Eritrea2002	69	58	0.16
India2002	636	601	0.06	Ethiopia2002	326	258	0.21
Nigeria2001	167	157	0.06	Zambia2002	173	123	0.29

ENDNOTES

[i] Studies like Escribano and Guasch (2005) are trying to address some of these problems, and as panel data becomes available, more rigorous methods can be applied..

[ii] Earlier analyses of firm survey data from Africa also attempted to account for indirect costs when measuring the value added of firms (see Biggs, Shah and Srivastava [1995]). However, due to lack of availability of comparator data outside Africa, these studies were not able to place Africa in a global perspective.

[iii] We have some recall data on inputs and outputs. The lack of panel data at this time restricts the methodologies available to address questions of firm behavior. Surveys in East Africa will soon yield second observations for firms in East Africa, but in general, multi-country census-style panel data is not yet on the horizon for Africa. Appendix 1 contains three tables with additional information on our data. Table A.1 describes basic indicators for the countries used in this analysis, Figure A.1 shows price levels for investment vs. consumption goods and Table A.2 describes data there were dropped from the analysis.

[iv] A few countries (e.g. Eritrea) lack specific data and therefore are only included in some exercises.

[v] Senegal, Tanzania, and Uganda are rated in the top tercile in Africa by the World Bank's Country Policy and Institutional Assessments (CPIA).

[vi] For a comparative review of some of these countries see Devarajan et al. (2001).

[vii] Ethiopian, Nigerian and Zambian firms also have high capital cost shares, though this figure may be deceptive because some firms own and operate fully depreciated equipment and hence have low capital costs from an accounting standpoint.

[viii] If anything, the share of indirect costs in total costs offers a conservative inference about the impact of poor infrastructure and public services on the input prices facing firms. For instance, transport costs on inbound raw materials often are absorbed in the price of materials rather than explicitly counted as transport costs. If 25% of the stated cost of raw materials in Kenya is actually transport costs, but the equivalent figure in China is 15%, it would mean that true indirect costs are 40% of total costs in Kenya compared to 22% in China.

[ix] For example, security is an input in the sense that the less of it a firm has, the lower its net output due to theft, vandalism and the like. In some places, public order is strong and the effective price of adequate security for a private firm is low. In others, public order is defunct and the effective price of maintaining an equivalent level of security by hiring guards and installing security systems is high. Analogously, in sparse, remote areas with poor roads, the effective price of transporting goods to the average customer or to port is very high compared to in dense areas with functional road and rail systems.

[x] For instance, Berndt and Wood (1975) find that energy (which accounts for more than a third of indirect costs in our sample) is strongly complementary to capital and only weakly substitutable for labor in the US. Jones (2007) makes this argument nicely (pg. 8), and underlines its implications for patterns of per capita income.

[xi] Without input prices one cannot estimate the underlying technological parameters of firms' production functions or cost functions. See Gorodnichenko (2005), Katayama et al (2006).

[xii] For a private, domestically owned, registered limited liability company of medium size in the largest city importing or exporting a medium-valued manufactured or processed product transported in a dry 20-foot cargo container via a seaport. *Source:* World Bank Global Logistics Indicators Survey.

[xiii] Uganda recently raised the price of public electricity to $0.175 per kWh in an attempt to reduce supply shortfalls.

[xiv] Calculated as (wage bill / labor force), deflated using Purchasing Power Parity.

[xv] African capital prices are 71% of US levels, compared to 75% (Middle East), 67% (Latin America), 71% (South Asia), and 37% (East Asia). Averages are weighted by country GDP.

[xvi] Confidence intervals can be constructed by taking the standard errors from Table 5.

[xvii] Mechanically speaking, if value-added is X% of sales, a 10% change in sales corresponds to a [10 / (X / 100)] % change in value-added.

[xviii] Easterly observes that the World Bank has made several loans to Kenya for road improvements with little to show for it, and that the Bank has argued more than a dozen times between 1990 and the present that Africa was "about to turn the corner" in terms of policy reform (Easterly, 2002). He also argues that donors have contributed billions of dollars to road

construction across Africa, but the overall quality of road networks has improved little due to poor maintenance.