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Wendy Carlin, University College London and CEPR
Mark E Schaffer, Heriot-Watt University and CEPR
Paul Seabright, Université des Sciences Sociales de Toulouse and CEPR

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Centre for Economic Policy Research
90–98 Goswell Rd, London EC1V 7RR, UK
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999
Email: cepr@cepr.org, Website: www.cepr.org

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ABSTRACT

Where Are the Real Bottlenecks? Evidence from 20,000 Firms in 60 Countries About the Shadow Costs of Constraints to Firm Performance*

We use data from over 20,000 firms in 60 countries to identify constraints on the growth of firms. We interpret managers' answers to survey questions on the extent to which various aspects of their external environment inhibit the performance of their firm as measuring the shadow cost of constraints to their activities, not as direct measures of the constraints. These costs can vary with firm characteristics as well as with the magnitude of the constraints themselves. Our model reveals that, contrary to common practice, the importance of an obstacle to performance is not, except under very restrictive assumptions, measured by the coefficient on the reported level of the obstacle in a performance regression. We test the predictions of the model on the large firm-level dataset and show how the importance of different constraints varies across countries and how the cost of a constraint depends on the characteristics of the firm. We find that telecoms are less important, and taxes more important, as constraints on performance than the literature has previously identified.

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Wendy Carlin
Department of Economics
University College London
Gower Street
London
WC1E 6BT
Tel: (44 20) 7679 5858
Fax: (44 20) 7916 2775
Email: w.carlin@ucl.ac.uk

Mark E Schaffer
Centre for Economic Reform
and Transformation
Heriot-Watt University
Riccarton
Edinburgh
EH14 4AS
Tel: (44 131) 451 3494
Fax: (44 131) 451 3294
Email: m.e.schaffer@hw.ac.uk

Paul Seabright
Institut d'Economie Industrielle
Universite de Toulouse-1
Manufacture de Tabacs
21 Allée de Brienne
31000 Toulouse
FRANCE
Tel: (33 5) 61 12 86 17
Fax: (33 5) 61 12 86 37
Email: seabrigh@cict.fr

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1. Introduction

A consensus has developed over the last decade or so that the quality of institutions is of critical importance to successful development, but there is no consensus on how to identify the dimensions of institutional quality that matter most. The main reason for this is that the country-level data that have principally been used to investigate the question can tell us what features of institutions typically accompany economic development. They can even try to use instrumental variables techniques to control for the endogeneity of these institutions. But studies of country-level data cannot easily identify the difference between a feature of institutions that accompanies or is associated with development and one whose absence would constitute a constraint upon development. In this paper we propose a new way of approaching the problem, based on the idea that many dimensions of institutional quality that potentially constitute a constraint upon development have the property of a public good. We show how to use the questionnaire responses of firm managers to identify such public goods, and draw conclusions for the role of public policy in setting priorities for their supply.

To identify institutional constraints on economic performance this paper uses detailed microeconomic data in a sample of over 20,000 firms in some 60 countries. These data consist essentially of the responses of firm managers to questions requiring them to state the degree of severity of a number of obstacles to the operation and growth of their business. We argue that such data can be informative about the way institutional constraints affect firm performance, but that their interpretation requires careful economic modelling. We set out a model based on the idea that the institutions in a firm's business environment have the character of public goods, which are an input into private production but whose availability may be in more or less restricted supply. This model reveals that, contrary to the common practice in much of the existing literature on this question, the importance of an obstacle to performance is *not*, except under very restrictive assumptions, measured by the coefficient on the reported level of the obstacle in a performance regression. When estimated on aggregate data, this parameter estimate is typically contaminated by the endogeneity of public good supply at a country level (better performing countries have higher levels of supply), and when estimated on disaggregated data by the endogeneity of demand for public goods at a firm level (better performing firms need higher levels of public good inputs)[1].

In the model we set out below, production requires a private input and a public good input. The private input is modelled as a single good that we interpret as labour but which can be understood as a composite encompassing other purely private inputs as well, including private capital. The public good may also be multi-dimensional and can be understood as including physical infrastructure, social conditions such as crime and corruption, macroeconomic and political conditions and so on. The key point is that the supply of the public good input is constrained at a level which is the same for all firms in a given country but typically varies between countries, with more prosperous countries usually having higher levels of supply. In addition the demand for the public good will typically vary between firms in the same country, with more highly performing firms demanding more of the public good and therefore feeling the

[1] The former point has been made (in the context of a different model) by Rodrik (2005).

supply constraint more keenly. These demand and supply endogeneities are crucial for the interpretation of any regressions in which the levels of these constraints as reported by managers appear.

One feature of the business environment that is different from the others is the availability and cost of finance. Although the financial system has some public good attributes, the characteristics of the firm concerned will typically affect the supply of finance to any given firm and not just the demand by that firm. Indeed, because of limited liability and the divergence of interests between managers and shareholders, a well-functioning financial system is one that should limit the availability of finance relatively more strictly to firms that are less likely to make productive use of it. In the model, the firm has a firm-specific financing constraint.

In the first part of the paper, we explain the motivation for thinking of institutional constraints in terms of public goods (Section 2) and incorporate private inputs, public good inputs and the firm's financing constraint in a simple model of firm behaviour (Section 3). This set-up allows us to draw out testable implications for the coefficients on the public good constraint variables in augmented TFP regressions estimated at firm- and at country-level. The model predicts that in the case of public good constraints the coefficients will be opposite in sign in firm- as compared with country-level regressions. Moreover, it predicts that this will not be the case for financing constraint variables. This exercise is conducted in Section 4 and provides support for the interpretation of the responses of managers to the constraint questions as 'shadow costs'. These results provides a rationale for using the ranking of the country average measures of these responses as indicative of the relative importance of different dimensions of public good infrastructure for firm performance in a specific country.

In the second part of the paper, we describe the cross-country rankings of constraints (Section 5) and show how this kind of data can be used for policy analysis (Section 6). A natural framework for applying the country rankings of the institutional constraints is the growth diagnostics approach proposed by Hausmann, Rodrik and Velasco (2005). HRV argue that the binding constraint to growth is likely to vary across countries and suggest a decision tree based on a canonical endogenous growth model as a method of identifying the binding constraint in a specific country. Macroeconomic data can help to pick out the binding constraint. However, the evaluation of constraints by managers provides a direct source of evidence that can be used to validate a macro-based diagnosis. Another policy-relevant application of the 'shadow cost' interpretation of the constraints data is to use it to identify the characteristics of firms likely to benefit most from a relaxation of a specific constraint.

2. The Business Environment as a Public Good

The great bulk of the empirical literature that seeks to identify institutional constraints on development uses a cross-country regression framework, estimated on the Summers-Heston GDP dataset. A notable example is the pioneering paper by Acemoglu, Johnson and Robinson (2001), which is widely considered to have established the importance of institutional quality for determining living standards. Sometimes, as in that paper, where the focus is on very persistent institutions, the variable measuring development is the level of GDP, but often (given the presence of

panel data stretching over four decades for a large number of countries), the variable is GDP growth, which allows a fixed effects treatment of the influence of time-varying country-specific characteristics on GDP levels. The empirical literature on the determinants of economic growth, launched by Barro (1991) and summarized in Barro & Sala-i-Martin (2003), was significantly enriched by the addition of measures of institutional quality, as in the widely-cited paper by Knack and Keefer (1997) on social capital. What the Acemoglu et.al. approach has added to that literature is a systematic treatment of the endogeneity of institutional quality.

Implicit in this regression framework is the assumption that performance is influenced by institutional constraints in a way that is common to all countries in the sample. There is, one might say, a common "technology" for transforming institutional endowments into performance. The institutional endowments may interact with other economic inputs, such as physical infrastructure (as in Esfahani and Ramirez, 2003). One may also allow for certain country- or region-specific particularities in the estimation through dummy variables (there is sometimes an "Africa-dummy" with a disturbingly negative coefficient). Nevertheless, these particularities can be no more than occasional exceptions in a framework that treats the performance of different countries as alternative realizations, due to differing endowments of physical or institutional inputs, of a common development process, albeit one whose determinants may stretch very far back in time.

Whatever else we may believe about the impact of institutions on economic development, economists agree that the true impacts are likely to be complex and non-linear. Institutions that appear to matter in some contexts do not appear to matter in others (a notable example is the importance of formal property rights, which remain weak in China, a weakness that has not prevented the country from enjoying the strongest episode of economic growth in the history of the world). While convincing explanations may eventually be found for the varying importance of particular institutions at different times and places, the common technology assumption implied by the regression framework obliges us to treat them as of equal importance to all countries unless convincing evidence has been found to the contrary and a statistically significant interaction term identified. Apart from anything else, this makes policy advice difficult – how confident can we feel about recommending a given policy for strengthening institutions to a government entirely on the basis of a cross-country regression with an R-squared of 0.3?

We propose here an alternative approach to the measurement of institutional constraints that is non-parametric in the sense that it imposes no prior restriction on the values that such constraints may take in a given country, either absolutely or relatively to their values in other countries. The underlying idea is that good quality institutions should be considered as a kind of public good, which may or may not be present in adequate amounts for the efficient functioning of firms in an economy. The importance of those institutions for economic performance will then be measured by their shadow price – the amount by which firms would perform better if the efficient level of the public good were present.

Why is the public good dimension important for our approach? Many purely private goods are ordinary inputs into production, and are typically more plentiful in countries that enjoy high levels of economic development. Cars, photocopiers,

vacuum cleaners, refrigerators, air conditioners all spring to mind – though the example of air conditioners reminds us that we need to control for other variables such as climate in assessing any statistical correlation between economic development and the availability of the good. Nobody, however, would consider the availability of such goods an institution-driven constraint on development. Individual economic agents can acquire more of these goods if they need them – their only constraint is an overall budget constraint. In economies facing serious internal disruption, as in conditions of war or civil disturbance, there may be problems with the availability of ordinary private goods, such as food or medicines, which may not be available at any realistic price. Less dramatically, some kinds of private good may face scale economies in production or distribution that make them unavailable at levels of demand below some threshold. However, this is not typically the kind of problem with which the literature on institutional constraints on development has been concerned.

We can contrast an institution-driven constraint with a resource-constraint: in the case of a non-tradeable good in fixed supply and essential to development, a country with a poor supply would face a high relative price for such an input and its growth would be resource-constrained. A second useful comparison is between an underlying institutional constraint and its manifestation, which may take the form of distorted prices. For example, poor trade policy or institutions may distort the price of an important tradeable private good input: firms cannot go out and buy better trade policy and are therefore institutionally constrained. In our interpretation, the problem of institutional constraints should be seen as an inadequate availability of public goods even when markets for most private goods exist and make them available subject to the budget constraints of agents.

To identify the current level of some good as constraining economic development is to say that economic agents cannot obtain as much of it as they would like to given current market prices, and their inability to do so has a shadow cost in terms of forgone economic development. Thus, if we identify (say) telecoms availability as a constraint on development, we are implicitly judging that the available quantity, and not just the price, of telecoms services affect the level of economic activity in the economy.

How can we find evidence about which dimensions of institutional quality are important for growth in this public good sense? One simple answer is to ask economic agents themselves to identify the specific goods and services whose availability (rather than just their affordability within an overall budget) acts as a constraint on their economic activity. In principle, if these responses are accurate and representative of the wider population, we should obtain a reliable picture of the constraints that matter for the activity of the economy as a whole. In practice, therefore, we need to make an assessment of how accurate and representative the responses are – a task we undertake in this paper.

As we describe below in more detail, the data with which we work consist of responses by firm managers to questions about the degree to which their firm's activity is constrained by inadequate features of certain institutions in their environment – notably by physical infrastructure, macroeconomic stability, the operation of government regulations and so on. A high average score for a given

feature is interpreted as meaning that managers perceive the inadequate state of that institution as imposing a large constraint on their business operations. Other things equal, therefore, we can conclude that public policy intervention to improve the state of the institution concerned would generate a large amount of additional economic activity.

The question of how representative are the responses is easiest to answer. Enterprises are not the only economic agents that matter in an economy. There are also individuals and households – and some institutions that matter for them do not matter very much for the activity of firms. More subtly, existing enterprises are not perfectly representative of the population of potential enterprises (namely those that would exist under better institutional conditions). There may be some types of regulation, for instance, that are not perceived as constraints by existing firms but which serve to make entry into the market much more difficult for new firms. These caveats should be borne in mind in interpreting the results of a study like the present one, but it remains an important exercise in our view to study the relative importance of constraints on the activity of existing firms.

The question of accuracy is more complex. There are of course doubts about the willingness and ability of managers to report accurately features of their firm's environment, especially those embodied in not-easily-quantifiable measures such as "degrees of severity". Biases such as over-optimism or (in the opposite direction) a tendency to complain may affect estimates of the true severity of these constraints. However, there is no particular reason to think, in most cases, that average *differences* in the reported severity of different constraints are likely to be biased (that is, there is usually no reason to think that optimism or grumpiness have a differential effect). If, on average in a given economy, firms report electricity availability to be a more severe constraint than telecoms availability, it seems likely that electricity is indeed the bigger constraint upon economic activity in the economy (in the sense that an increase in the quantity of electricity supply to match existing demand *at current prices* would result in a larger increase of firms' output). If current prices correctly reflect shadow costs to the economy, and in the absence of externalities, that will also imply that the social benefit-cost ratio of such an increase would be higher for electricity than for telecoms – a clear example of a public policy recommendation soundly based on an empirical finding.

However, there are some kinds of institutional feature where there may be doubts about accuracy that do indeed affect differences in reported severity. Most important among these are the responses regarding availability of finance. If finance had the character of a public good like telecoms or electricity one could interpret a high score on the constraints measure as indicating that output would respond strongly to an increase in the availability of finance. But finance is different – banks lend money to managers whose interests are not identical to those of shareholders, and shareholders in turn do not internalise the full costs of their borrowing decisions, due to limited liability. Increased availability of finance may enable profligate managers to fund pet projects that, on average, do not increase economic activity but which merely increase default rates, the costs of which are borne by lenders. A perception that the supply of finance is a constraint on the activity of at least some managers is something that *should* characterize an effective set of financial institutions, unlike in the case of institutions such as physical infrastructure. Finance has the additional feature that – if

the institutions are working well – the perception of its availability as a constraint should be *inversely* related to the quality of investment projects the firm has available to fund, so that high scores may indicate poor quality projects rather than the potential for increased output. We discuss this issue further below.

In sum, therefore, the perception of the relative importance of different institutional constraints on firm activity does appear to tell us something of importance for policy, provided we remember both that they tell us only about constraints on existing firms and that financial constraints need to be identified in a quite different way from those associated with institutions that have the character of public goods.

3. A Lagrangian Approach to Identifying 'Business Environment' Constraints

> "Other aid community jargon (like 'good investment climate') simply lacks any meaning that economic science can discover. You might as well say 'the investment climate will be stormy in the morning, gradually clearing by afternoon with scattered expropriations'"
> William Easterly, 'The Cartel of Good Intentions: Bureaucracy versus markets in foreign aid', Center for Global Development Working Paper Number 4, March 2002 (revised April 2002), p. 31.

In this section we set out a framework for thinking about the relationship between reported constraints and the characteristics of firms. The aim is both to suggest that terms like the business environment and the investment climate can be given a more precise sense than Easterly says is possible, and also to reinforce his scepticism about the value of imprecise formulations of these same ideas.

We start with a simple 1-period model of a profit-maximizing firm which uses a private good and a public good to produce output. We shall call the private good "labour" but it will also include physical capital in the form of machines and so forth. We shall call the public good "infrastructure" but it will also include any aspect of the institutional environment that has an effect on output but that firms cannot simply purchase in the marketplace at a common price: firms faced a common constrained supply of infrastructure. Financial capital is not explicitly represented in the model but enters in effect via a cash-in-advance constraint on the payment of labour. We shall see below that the cash-constraint is interpreted as one that can vary between firms in the same economy, while the infrastructure constraint is the same for all firms in the same economy (though its shadow cost to the firm will typically vary across firms). Variables that vary at the level of the firm are indexed by i.

- There are two inputs: labour, denoted by L, and infrastructure, denoted by Z.
- There is one output, Y.
- There is a tax t_Y on output, which can be interpreted either as formal taxes or as corruption, transport costs and so on.
- There is a tax t_L on labour, which can be interpreted either as a formal payroll tax or as labour regulation.
- The supply of the public good is constrained to be no more than a certain amount.

The production function is Cobb-Douglas:

$$Y_i \equiv F(L_i, Z_i) = A_i L_i^{\alpha} Z_i^{1-\alpha},$$

$$\text{which implies } \frac{\partial Y_i}{\partial L_i} \equiv F_{L_i} = \alpha A_i L_i^{\alpha-1} Z_i^{1-\alpha} \tag{1}$$

$$\text{and } \frac{\partial Y_i}{\partial Z_i} \equiv F_{Z_i} = (1-\alpha) A_i L_i^{\alpha} Z_i^{-\alpha}.$$

The profit function is therefore:

$$\pi_i = (p - t_Y) Y_i - (w + t_L) L_i - c Z_i. \tag{2}$$

The cash-in-advance constraint requires the wage bill not to exceed beginning-of-period money balances (it is assumed that infrastructure is paid for out of realized revenues):

$$M_i = (w + t_L) L_i \leq \overline{M_i}. \tag{3}$$

The infrastructure supply constraint says that

$$Z_i \leq \overline{Z}. \tag{4}$$

The firm's profit-maximisation problem therefore yields the following Lagrangian:

$$MaxV_i = (p - t_Y) Y_i - (w + t_L) L_i - c Z_i + \mu_i \left(\overline{M_i} - (w + t_L) L_i \right) + \lambda_i \left(\overline{Z} - Z_i \right). \tag{5}$$

In the case where both constraints bind, the optimized values of labour and infrastructure are directly determined by the cash and infrastructure constraints respectively.[2] This allows us to write maximized profits as a function of exogenous variables:

$$\begin{aligned} \pi_i^* &= (p - t_Y) F\left(L_i^*, \overline{Z}\right) - (w + t_L) L_i^* - c\overline{Z} \\ &= (p - t_Y) A_i \left(\frac{\overline{M_i}}{w + t_L} \right)^{\alpha} \overline{Z}^{1-\alpha} - \overline{M_i} - c\overline{Z}. \end{aligned} \tag{6}$$

We can therefore write the costs of the cash and infrastructure supply constraints in terms of the derivatives of the profit function:

$$\mu_i = \frac{\partial \pi_i^*}{\partial \overline{M_i}} = \alpha A_i \frac{(p - t_Y)}{(w + t_L)^{\alpha}} \left(\frac{\overline{Z}}{\overline{M_i}} \right)^{1-\alpha} - 1 \tag{7}$$

[2] This implies that each firm is at a corner solution and would not change its input choices even if there were a small change in its input prices, so standard comparative static analysis with respect to such prices would not apply. What interests us in this paper, however, is comparative static analysis with respect to the costs of the constraints, which remains possible and indeed highly interesting. Furthermore, the fact that each firm is at a corner solution poses no problems for the empirical estimation since each firm is at its own individual corner – the costs of the constraints typically vary both between countries and between firms within the same country, giving us the necessary variation in the regressors to make econometric analysis possible.

$$\lambda_i = \frac{\partial \pi_i^*}{\partial \overline{Z}} = (1-\alpha) A_i \frac{(p - t_Y)}{(w + t_L)^{\alpha}} \left(\frac{\overline{M_i}}{\overline{Z}} \right)^{\alpha} - c. \tag{8}$$

Some simple comparative static results follow from this:

$$\frac{\partial \mu_i}{\partial A_i} > 0, \frac{\partial \mu_i}{\partial \overline{M_i}} < 0, \frac{\partial \mu_i}{\partial \overline{Z}} > 0,$$
$$\frac{\partial \lambda_i}{\partial A_i} > 0, \frac{\partial \lambda_i}{\partial \overline{Z}} < 0 \ \frac{\partial \lambda_i}{\partial \overline{M_i}} > 0, \ \frac{\partial \lambda_i}{\partial c} < 0. \tag{9}$$

The shadow cost of each constraint is increasing in the productivity parameter *A*, decreasing in the level of constraint itself, and increasing in the other constraint (a tighter cash constraint reduces the cost of the infrastructure constraint, and conversely). In addition the cost of the infrastructure constraint (λ) is decreasing in the price of infrastructure – infrastructure shortages are perceived as a greater constraint when the price of infrastructure is low. For any given level of infrastructure supply, countries that underprice their infrastructure stimulate demand that increases overall shortages (a particular problem in some countries where infrastructure pricing responds to political pressure from powerful lobby groups).

We expect the level of the cash-constraint $\overline{M}$ to be correlated with other parameters that vary between firms, such as productivity, with more productive firms being less cash-constrained. This has an ambiguous effect on the reported cost of the cash constraint since we have seen that μ is increasing in *A* but decreasing in $\overline{M}$, which is itself likely to be increasing in *A*. Given that production takes place over time, $\overline{M}$ will probably be associated with past levels of profits, so that the causality between the cash constraint and profits will run in both directions. If the model is extended to two periods, so that profits in the first period are carried over to the second period, we get

$$\frac{\partial \mu_{i2}}{\partial A_{i1}} < 0. \tag{9a}$$

We can also write the derivatives of the profit function with respect to the taxes on output and labour for comparison:

$$\frac{\partial \pi_i^*}{\partial t_Y} = -A_i \left(\frac{\overline{M_i}}{w + t_L} \right)^{\alpha} \overline{Z}^{1-\alpha} < 0 \tag{10}$$

$$\frac{\partial \pi_i^*}{\partial t_L} = -\alpha A_i \frac{(p - t_Y)}{(w + t_L)^{1+\alpha}} \overline{M_i}^{\alpha} \overline{Z}^{1-\alpha} < 0, \tag{11}$$

from which it follows that the cost of the output and labour taxes in terms of forgone profits is less when the cash and infrastructure constraints bind more tightly, and is greater for more productive firms.

We can now use these comparative static results to summarize predictions about how we would expect to see the reported values of the constraints differ across firms and

across countries. First of all, we note that the level of the constraint $\overline{Z}$ will be the same for all firms in the same country (that is what we mean by calling it a public good). This does not mean that the shadow *cost* of the constraint, λ, will be the same for all firms. On the contrary, the cost will be perceived as greater by those firms that, for other reasons, would wish to use higher amounts of the infrastructure input – notably those that are more productive (higher A) and less cash-constrained (higher $\overline{M}$). This is why we should expect to see a somewhat positive association between firm performance and the cost of the infrastructure constraint within each country, in contrast to the negative association we should expect to see across countries (which reflects variation in the level of the constraint itself, i.e. in the supply of infrastructure). Note that even when the supply of infrastructure is optimal, shadow costs will vary across firms – just as marginal valuations by consumers vary for pure public goods optimally supplied.

Across countries the average level of $\overline{M}$ can be expected to increase with productivity (more developed countries are able to channel a larger flow of resources through their financial systems). Furthermore, the more effective the financial system the stronger we should expect the within-country positive association between A and $\overline{M}$ to be, offsetting more strongly the positive impact of A on μ. This means there should be a cross-country relationship between the strength of the within-country association between A and μ, with a more negative association the more developed the financial system.

Note, however, that the negative association we see between firm performance and the average shadow cost of the constraint across countries will not provide an accurate measure of the extent to which relaxing the constraint would improve performance except in the very special circumstances where variation in the level of the constraint is solely causally responsible for the performance improvement itself. If two countries are otherwise identical except that one has a different level of some constraint, the performance in the two will differ to a degree that precisely reflects the deficiency in infrastructure supply. But if performance varies for reasons that are not fully controlled for, or if (as seems likely in many circumstances) factors that improve a country's overall performance also lead it to increase the supply of some public good, thereby relaxing the constraint, the cross-country statistical association will give an upward-biased (in absolute value) estimate of the cost of the constraint. We consider this in more detail in Section 5 in relation to the interpretation of cross-country patterns of telecom constraints.

As in the case of public good constraints, we assume that output and labour taxes, the price of output and the price of infrastructure are the same for all firms in each country, though they may vary across countries. To the extent that output taxes can be interpreted more generally as "corruption", their incidence could vary across firms, with better-connected firms suffering less from corruption (e.g., Hellman and Schankerman, 2000). Once again, the cost of the output and labour taxes will be greater for more productive and less cash-constrained firms, so there will be a positive within-country relationship between firm performance and the perceived cost of these taxes, while across countries lower taxes will be associated with better performance (higher output and profits).

We have therefore the following predictions:

- Between country: the cost of both the infrastructure and finance constraints is decreasing in country-average firm productivity and performance.
- Within country: the cost of the infrastructure constraint is increasing in firm productivity and performance. The cost of the finance constraint is ambiguous but likely to be decreasing overall in firm productivity and performance. Furthermore, this relation should be more negative the more developed the financial system.

4. Testing for Predicted Biases in Production Function Estimates that use Business Environment Data

From the model in Section 3, we move to a regression framework. The purpose, however, is not to estimate either the production function or equations (7) and (8). None of these three equations can be estimated directly since they all contain as arguments the supply of infrastructure, which is not directly observed in the data, and cannot be recovered implicitly from the data except under a hypothesis of exogeneity that we have argued to be highly implausible. Rather, what we do here is to use the comparative static properties of the model in the inequalities (9) and (9a) to predict what we are likely to observe when, as is generally done in the literature, a misspecified version is estimated (using data on the costs of the constraints) that does not take into account the endogeneity of the constraint variables both within and between countries.

The data we use are the fruit of a vast effort in recent years to collect firm-level data on the quality of the institutional environment in which firms operate. Both the World Bank and the EBRD have undertaken large numbers of firm level surveys with the express intention of measuring the quality of the 'business environment' or the 'investment climate'. By now, there are some 120 cross-sectional surveys covering up to 47,000 firms in total located in more than 60 countries. Details of the surveys and data are in the Data Appendix. These 'business environment' surveys focus on institutions, interpreted as the rules of the game in which firms are engaged, the organizations that implement these rules and the services provided. They gather information on a firm's experience of physical and communications infrastructure (e.g., outages and connection delays), legal and regulatory institutions (e.g., bribes paid to get things done, losses due to crime, delays at customs posts), and the financial system (e.g., cost of and access to finance). They also gather information on the assessment by managers of the importance of each aspect of the business environment for the operation and growth of the firm. The question asked of the manager is:

> 'I would now like to ask you questions about the overall business environment in your country and how it affects your firm. Can you tell me how problematic are these different factors for the operation and growth of your business?'

The manager responds on a 4-point scale 'No obstacle (1)' to 'Major obstacle (4)'. A list of the aspects of the business environment managers are asked to evaluate can be found in Table A4 in the Appendix.

The first step is to look for evidence that the within and between country coefficients on the measure of the constraint in the estimation of an augmented production function differ in the ways predicted. We use firm level data and panel estimation, where the countries provide the panel element. One equation is estimated for each of

the constraints. The production function is Cobb Douglas and the regressors are capital and labour inputs (in logs), a set of controls, and the manager's evaluation of the constraint.

We begin this section by demonstrating how the reverse causality problem is manifested using the example of a production function augmented to include business environment constraints. The reverse causality problem can be neatly demonstrated empirically using our cross country firm-level dataset as follows. Consider a simple panel formulation of a Cobb-Douglas production function for firm *i* in country *j*:

$$\log Y_{ij} = \beta_0 + \beta_L \log L_{ij} + \beta_K \log K_{ij} + \delta C_{ij} + X_{ij}\Gamma + u_j + e_{ij}, \qquad (12)$$

where u_j is the unobserved country-specific productivity effect, e_{ij} is the firm-specific error term, C_{ij} is an assessment of a business environment constraint reported by the firm, and X is a vector of firm-level characteristics that might be expected to influence firm productivity. C_{ij} is defined to be increasing in the severity of the constraint. The reverse causality problem is that C_{ij} is highly endogenous – what the firm reports as a major constraint is very likely to be correlated with the error term e_{ij}, the unobserved idiosyncratic component of productivity. This will be true even if (12) is estimated using the within (fixed effects) estimator, so that the country specific component u_j is differenced out. Although the true value of δ in the production function model should be negative, i.e., a worse business environment as a proxy for higher constraints reduces productivity, this will only be the case if C_{ij} is an (inverse) measure of the supply of infrastructure to the firm. Under the assumption that supply of infrastructure is common to firms within a country, this effect is not identified in a fixed effects regression. Our model suggests that the valuations we observe (C_{ij}) are a measure of the difference between the firm's desired use of the public good (the notional demand) and its actual use (the observed demand, which is equal to supply). As the gap between the firm's desired use of infrastructure and its availability narrows, the cost of the constraint declines (when the gap disappears, the firm records that the constraint is unimportant for the operation of its business). Heterogeneity in firm quality moves the demand curve for infrastructure. By contrast, the usual interpretation of an augmented production function estimated with country fixed effects is that firm heterogeneity allows the econometrician to identify the effect of a variation in infrastructure *supply* on firm productivity and, if satisfactorily instrumented, to make deductions about the causal impact of institutions on productivity.

As discussed in Sections 2 and 3, the public good interpretation does not apply to the case of financial constraints. Since better performing firms generate internal profits they may report that they are less constrained than poorly performing firms, whose managers may want to blame their problems on "not enough money". Although the reasoning is different, reverse causality biases the coefficient δ, in this case making it more negative than the true value.

If (12) is estimated using the between or country averages estimator, the results should be different. Since there are many firms in a country, the correlation of the country mean of the reported business environment constraint $\bar{C}_j$ with the country error term $u_j + \bar{e}_j$ will be approximately equal to the correlation with the pure country

effect u_j. The estimate of δ will be an estimate based on the average reported business environment constraint for different countries – a cross-country estimation framework that is also common in this literature. A comparison of the sign and significance of estimates of δ for various business constraints in the within and country-averages regressions can therefore show the presence of the reverse causality problem. We note here that this is essentially the same argument that Mairesse (1990) employs in the context of production function estimation using time-series/cross-section data on firms: if factor inputs are correlated with the time-varying error e_{ij}, the within estimator will be biased, but the between estimator "will be much less affected by these correlations, since … [e_{ij}] is averaged in the between regression and is practically wiped out for large enough T", where T is the number of time series observations (p. 86). The argument is strengthened in our application because the number of firms in a country survey is very large compared to the typical T in a time-series/cross-section panel.

To summarize, if the fixed effects estimate of δ is perversely positive, this is because of the dominant bias involving e_{ij} (high productivity firms are more constrained). If the between estimator is negative this is partly because of the genuine negative impact of business environment constraints and partly because of the standard problem of bias because the country-average reported constraints are correlated with other things that also reduce country-average productivity. There will, in addition, be some attenuation bias (toward zero) as a result of measurement error. This examination of the impact of bias emphasizes that a finding of a positive sign on the fixed effects estimate of δ is a signal that reverse causality from firm performance to the evaluation of the constraint is dominant.

RESULTS

We estimated (12) using the within and between estimator on a sample of 20,326 manufacturing firms from 96 surveys in 59 countries (Table 1). Standard errors are robust to within-country correlation. The dependent variable was sales in constant prices (value added was unavailable for much of the sample; see the Appendix for details). The simple production function estimation without business environment constraint variables generated credible results in both specifications. It is reassuring to note that the capital and labour elasticities are plausible, though these are not the coefficients that interest us in this paper.[3] The other covariates were ownership (privatised is the omitted category) and location. Not surprisingly given their limited cross-country variation, the firm-level covariates were more significant in the within estimation, and in the expected directions.

[3] The differences in the estimated capital and labour elasticities in the within vs. between estimations may be attributed in part to different correlations of the error terms – e_{ij} in the former and u_j (approximately) in the latter – with factors of production. See Mairesse (1990).

Table 1. Panel estimation of a simple production function: within country vs. between country estimates

	Within		Between	
Log K	0.370**	(0.019)	0.702**	(0.056)
Log L	0.703**	(0.027)	0.575**	(0.121)
Foreign owned	0.412**	(0.086)	0.600	(0.379)
State	-0.357**	(0.103)	-0.740	(0.844)
New private	0.050	(0.038)	0.604	(0.393)
Big city	0.096*	(0.041)	-0.276	(0.295)
R-sq	0.7155		0.7826	
N (firms)	20,326			
N (surveys)	96			
N (countries)	59			

Note: ** significant at 1%; * significant at 5%.
Standard errors (in parentheses) robust to heteroskedasticity and clustering on countries. The omitted category is privatised firms. Private firms without a state-owned predecessor are classified as new private. Table A3 in the Appendix shows the distribution of firm ownership types across countries.

The estimates of country-level productivity (country dummies in the within estimation; residuals in the between estimation) were cross-checked with per capita GDP, which we know is positively correlated with aggregate per capita TFP, and are shown in Figure 1; there is a very strong positive correlation for the country dummies and a weaker but still clearly positive correlation for the residuals from the between estimation.[4]

When the business environment constraints are added, each in a separate regression, the results are as summarized in Table 2. They are broadly in line with expectations. The within country estimates are either insignificant or perversely positive, and the between estimates from the estimations using country averages are frequently negative and are significant for constraints relating to physical infrastructure. The key exception, also as expected, is for financial constraints, which is significantly negative in both within-country estimations. We also found that in countries with poor financial institutions (as measured by the Djankov, Mcliesh and Shleifer, 2005, indicators) there is no negative relation between TFP and the reported severity of financing constraints. However, as predicted, in countries with better institutions, the negative relationship appears (and is significant at the 5% level for the Access to Finance constraint). The regression results and a description of the indicators of financial development are presented in the Appendix.

[4] The TFP residuals shown in Figure 1 are from the within and between estimation of a Cobb-Douglas production; no explanatory variables appear other than capital and labour.

Figure 1a: Scatterplot showing correlation between GDP per capita and country-level TFP based on the dummies in a within regression

Figure 1b: Scatterplot showing correlation between GDP per capita and country-level TFP based on the residuals in a between regression

Table 2. Business constraints and productivity: within vs. between country estimates

Constraint	Within	Between
Telecoms	0.011	-0.445**
Electricity	0.005	-0.298**
Transport	0.023†	-0.284
Land access	0.014	-0.412**
Tax rates	0.001	0.049
Tax administration	0.002	-0.102
Customs regulations	0.055**	-0.275†
Licences	0.021	-0.210
Labour regulation	0.011	0.025
Access to finance	-0.038**	-0.053
Cost of finance	-0.030†	-0.100
Policy uncertainty	0.015	0.006
Macroeconomic stability	0.019	-0.081
Corruption	-0.002	-0.131
Crime	-0.016	-0.063
Skills	-0.011	-0.306
Anticompetitive practices	0.010	0.057
Legal system	*0.026***	*-0.018*
Mafia	*-0.014*	*-0.401*†
Contract	*-0.014*	*-0.064*
Land title	*-0.008*	*-0.456*†

Note. ** significant at 1%; * significant at 5%; † significant at 10%.
The table reports the coefficients on the constraint variable in the production function equation. Each row represents a separate regression of the form shown in Table 1 with a business constraint variable as an additional repressor.
Standard errors robust to heteroskedasticity and clustering on countries.
The average number of firms in each regression is about 17,000 drawn from 57-8 countries and 92-3 surveys, with the exception of the final four constraints where there are 10,000 firms from 48 countries for legal system and 3,100-3,800 firms from 29-34 countries in the remainder.

The within-country results for public good and finance constraints in this section are consistent with the presence of the biases predicted by our model. They caution against using regressions of this kind as a method of uncovering the impact of institutions on firm performance. The results for the between country estimates point to the expected negative (although not always significant) correlation between the extent of constraints and productivity. The lack of satisfactory instruments for the infrastructure variables makes it difficult to use this approach to determine whether a particular dimension of institutions or infrastructure is causally responsible for low productivity. The problem lies with finding a way of confidently rejecting the hypothesis that development that is taking place for other reasons brings in its wake institutional and infrastructure improvements.

Attempts have been made to get around these problems using the same kind of data and a production function framework by using a jack-knife approach where the

constraint variable for firm *i* is calculated by averaging the evaluations of the constraint by firms other than *i* in the same country, 2-digit industry and size class (Commander and Svejnar, 2007). They find that when country fixed effects are omitted from the augmented production function estimation, the constraint variables when entered individually typically attract a negative often significant coefficient but once the fixed effects are included, the significance of the constraint variables disappears. These findings are consistent with the structure of our model and with our own results. Our model is premised on the assumption that the supply of infrastructure (or business environment services) varies at country rather than at firm level. Our model also predicts that the coefficient on the constraint variable defined by other firms is likely to be insignificant (and difficult to interpret) in the country fixed effects formulation. The reason is that to the extent the variable captures the responses of firms similar to firm *i*, it is measuring the firm's demand for infrastructure (with the same reverse causality problem) and to the extent it captures the average firm in the country, it is measuring the country-wide supply of infrastructure and the effect will disappear when country fixed effects are included. Excluding the firm's own evaluation of the constraint does not solve the fundamental identification problem discussed above. Neither is the problem solved by the use of firm-level panel data, which will pick up changes in the valuation of constraints associated with changes in productivity but not the effect of changes in the supply of institutional quality on performance.

5. Data on Reported Constraints: Descriptive Findings

The results in Section 4 are consistent with the hypothesis that managers answering a question about a business environment constraint provide an evaluation of the shadow cost of the constraint to their business. This suggests that we look at the raw data to see what they reveal about the importance of different reported constraints. Unlike objective indicators of constraints such as the delays encountered at customs or the frequency of electricity outages, the subjective score for the significance of constraints enables the problems imposed by, for example, poor quality customs institutions to be compared with those associated with electricity supply in a particular country. We present the data in two ways. First, we look at the constraints that are reported as *relatively* important for the countries concerned (relative, that is, to the other constraints for that country). So as not to overinterpret the fineness of the distinction made by managers on the degree of importance of a constraint on a 4 point scale, in this exercise we simply look at constraints rated as above or below average importance in the country. Specifically, for each constraint we examine for which countries that constraint ranks as relatively important. The results are shown in Figure 2a. The constraints are ordered from right to left according to the total number of countries (out of 62), for which that particular constraint was rated as of above average importance. Secondly, we look at the constraints that are reported as absolutely important, in the sense that they score above 2.2 (which is the average score across all constraints for all countries). Scoring above 2.2 is in some sense a signal that the constraint is absolutely costly for firms in the country concerned. The results are shown in Figure 2b.

Figure 2a. The relative importance of constraints by country group
Each bar shows the number of countries in each country group for which the constraint is ranked more important than the average constraint for that country.

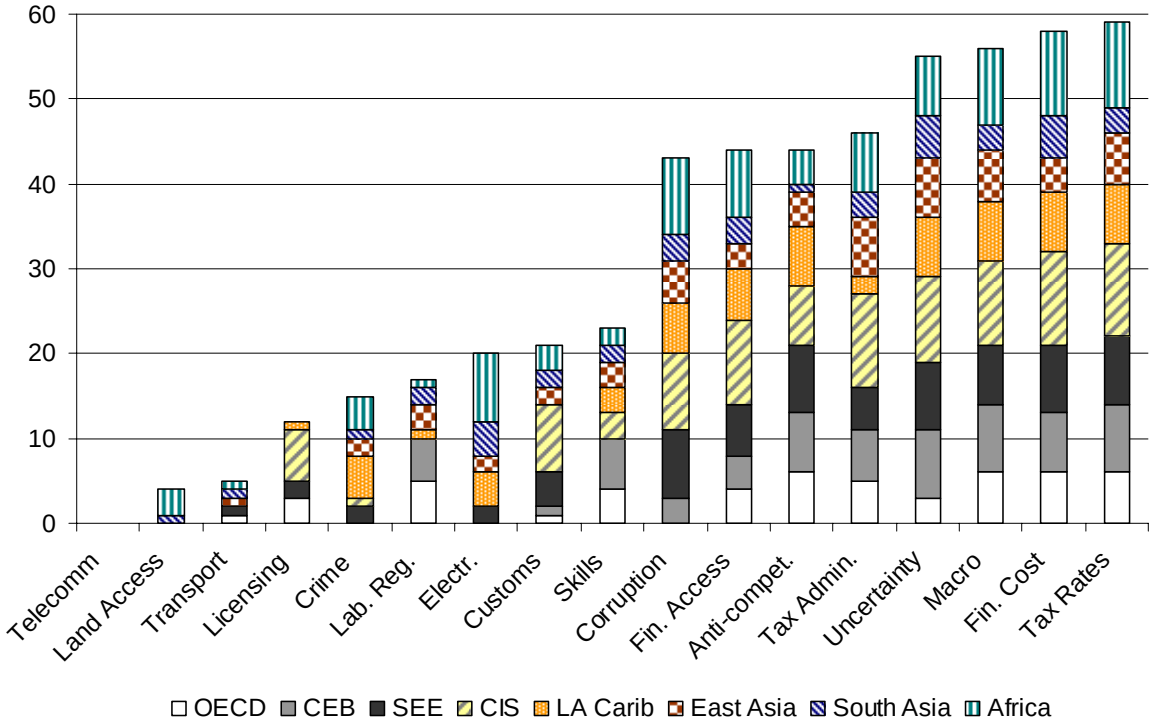
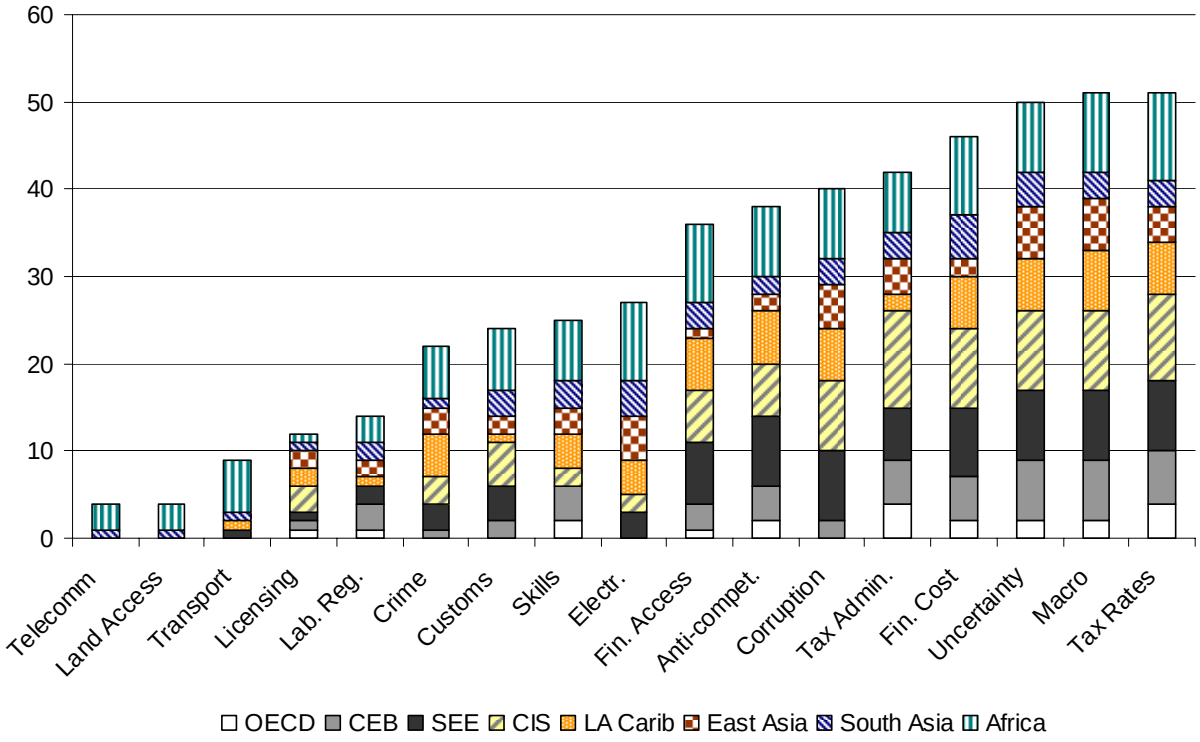


Figure 2b. The absolute importance of constraints by country group
Each bar shows the number of countries in each country group for which the constraint is ranked higher than 2.2 (the average across all constraints and all countries).



Neither of these two measures is intrinsically the 'right' one; they report different things. In principle the absolute score of a constraint is the correct measure of the value of the Lagrangian for that economy, and a country whose scores are higher on average than those of another is a country facing more constraints overall on the supply of public goods. In practice, though, the relative scores may be of interest as well, for two reasons. One is that we cannot rule out the possibility of systematic variations between countries in the tendency to complain; using relative scores is like estimating a fixed effects regression to control for such effects (at the cost, of course, of being unable to explain systematic differences between countries that are not just differences in reporting). The second reason for being interested in relative scores is that countries are the right focus for policy-making, since far more of the effort in policy-making is directed to deciding between alternative uses of resources within countries than in deciding between alternative uses of resources across countries. In measuring the relative importance of a constraint we are capturing where the priorities of policy-makers in that country should be directed, even if there are variations between countries that the measure does not capture.

The constraints fall into three groups: those that appear very infrequently as of above average importance (Telecommunications, Land Access and Transport); those that are important in between one-fifth and one-third of countries (from Licensing to Skills in Figure 3a) and a final group comprising the constraints that appear to be of above average importance in more than 70% of countries (from Corruption to Tax Rates).

Countries are classified into eight groups: Africa (with 10 countries), South Asia (5), East Asia (7), which includes China and Vietnam, and Latin America and the Caribbean (7). In addition there is an OECD European group (6) and three groups of transition economies from the former Soviet bloc: Central and Eastern Europe including the Baltic states (8), South Eastern Europe (8), and the CIS (11).[5] Since the surveys for about half the countries only include manufacturing firms, the data in Figure 3 is for the responses from manufacturing firms only.

A number of points emerge from these data:

- Physical infrastructure rarely rates highly as a constraint. Land access appears only in three African countries, Eritrea, Ethiopia and Mali; transport in a handful of poor or war-torn economies (including Sri Lanka and Kosovo) and also in Ireland. Telecommunications does not appear at all, suggesting that the presence of privately provided mobile telephony has much diminished the public good aspect of this traditional component of infrastructure. Electricity stands out as the key physical infrastructure problem that constrains firms – rated as of above average importance in a third of the countries (including all countries in Africa (apart from South Africa) and in South Asia (except Oman)). The only transition countries where electricity is cited as problematic are Kosovo and Albania, where it is the top-ranked constraint.
- Problems with licensing and customs affect relatively few countries in aggregate (less than one third) but are especially prevalent in the CIS countries.

[5] In the descriptive data, 62 countries are included for which there is data on all 17 dimensions of the business environment. So as not to proliferate the number of groups, Oman is included in South Asia and Turkey in the OECD European group. These groups are only used for the descriptive data presented in Figure 3.

- Crime and/or corruption show up as important constraints in all groups of countries except the OECD: crime in only one-quarter of countries and corruption in 70%. In Central and Latin America, if we exclude Chile, then in 5 of the other 6 countries, crime is ranked above average as a constraint, and corruption in all six. For four of those countries, crime or corruption is the top-ranked constraint. The only other countries where corruption is top-ranked are Cambodia, India and Kenya.
- There are seven dimensions of the business environment that are ranked as of greater than average importance in all country groups: anti-competitive practices, tax rates and tax administration, access to and cost of finance, and policy uncertainty and macroeconomic stability.[6] Perhaps not surprisingly, complaints about the burden of the tax rate are virtually universal. It is striking that in the CIS, tax administration is scored as more problematic than the tax rate in almost half of the countries, including Russia. It is also rated as more problematic than corruption in all CIS countries except Georgia. It is in the CEB and OECD countries that the tax rate most often shows up as the highest ranked constraint – it is reassuring to see that an exception is Estonia where the tax rate attracts a relatively low score and where skills and then labour regulation are ranked as the most important constraints. In South East Europe, policy uncertainty is the most common top-ranking constraint; in East Asia, it is macroeconomic policy and in Africa, it is the cost of finance. Unsurprisingly, South Africa's profile is quite different from the rest of Africa: the constraints ranked most highly there are labour regulation, skill shortages, macroeconomic stability and crime.
- There are few if any important differences between the ranking of constraints by relative importance (in Fig. 2a) and their ranking by absolute importance (in Fig. 2b). The differences that do exist concern constraints that affect countries at one end or the other of the spectrum of prosperity. For instance, while telecoms constraints rank as absolutely important in 4 countries out of 55, these are countries with many other problematic constraints, so that telecoms *never* rank as relatively important. Labour regulation, by contrast, ranks as relatively important for more countries than report it as absolutely important; this reflects the fact that labour regulation is reported as important only in comparatively rich countries whose other constraints score low. Interestingly, we found that for none of the constraints is there a significant relationship between the evaluation of its importance as an obstacle to firm performance and GDP per capita.[7]

In view of the unfamiliar nature of this data, it is useful to show the distribution of the firm-level answers across the 4-point scale for a selection of constraints. This is done

[6] The outliers here are Asia (South and East), where access to finance is a problem in fewer countries than are most other constraints; in Central and Latin America where tax administration is less problematic than many other constraints; and in the OECD where policy uncertainty is less frequently problematic than are other constraints. Firms in South Asian countries do not rate anti-competitive practices as problematic and nor is it reported as a major problem in African countries.

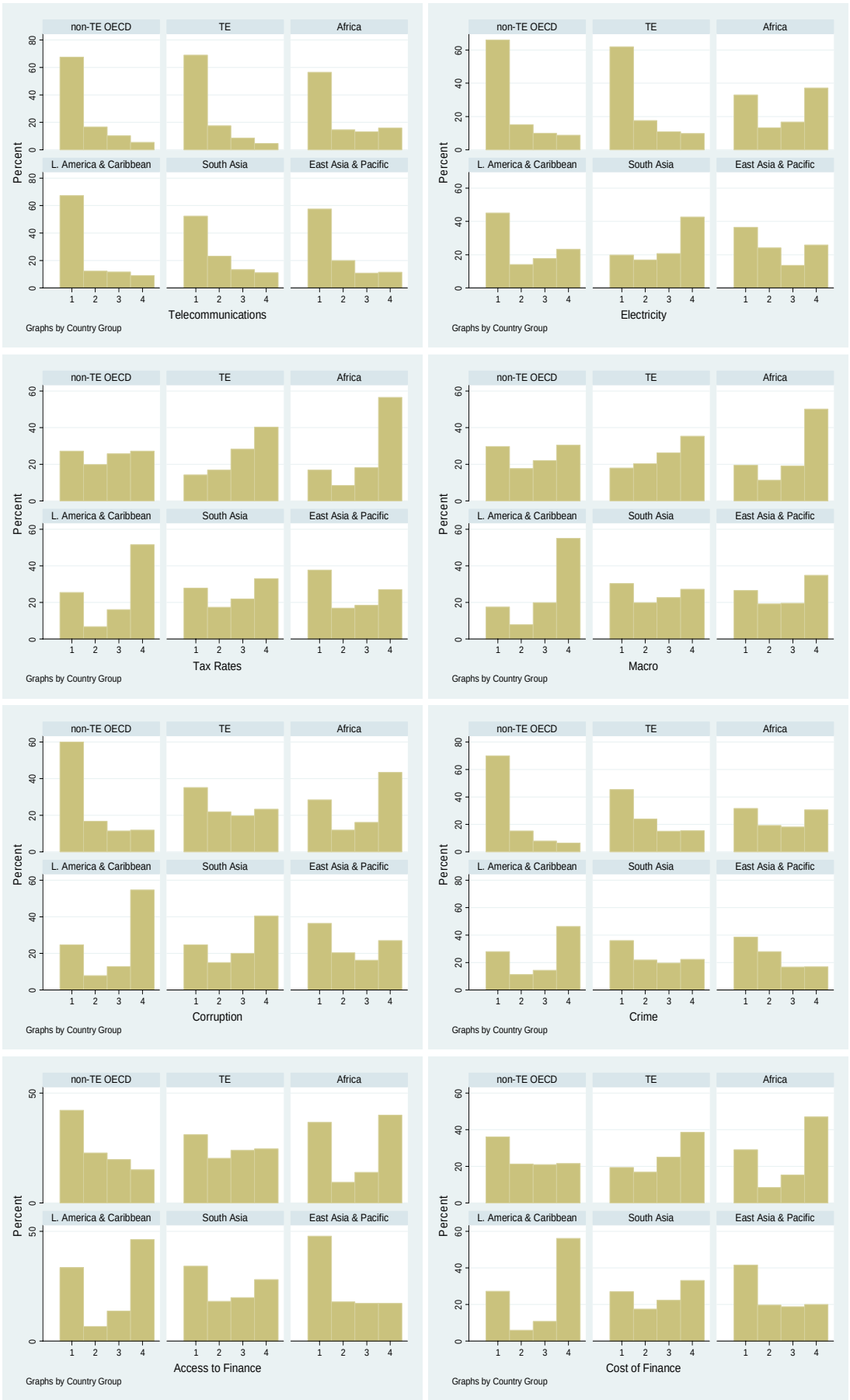
[7] To test for this relationship, we first stacked the data so that we had a dataset of over 400,000 managerial responses. We then created dummy variables for each type of constraint, so that in a regression on just the dummies (plus country fixed effects), the coefficients on the dummies would be estimates of the managerial evaluations of the constraints. Finally, we interacted the dummies with country GDP; and added the full set of interactions to this regression. The coefficients on the GDP*constraint interactions were all insignificant. Standard errors robust to clustering on country were used for inference.

in Fig. 3. For ease of presentation, we have amalgamated the three sets of transition countries into one group. The histograms of the micro data illustrate the intensity and variability of the constraints by country group. Many of the features picked out in the above discussion are displayed here as well but the histograms also underline the potential of the data to throw light on how constraints vary across and within countries by highlighting the precision of the evaluations. The bimodal patterns invite the question as to whether these arise from the heterogeneity within the country group or between different kinds of firms at the country level (e.g. Chile accounts for some but not all of the concentration of firms at the 'No obstacle' end of the spectrum for 'Corruption' in the Latin American and Caribbean group).

How surprising are these results? From the perspective of transition economies, the general absence of concern with physical infrastructure accords with other results. More surprising is the specific concern with tax administration that emerges in the CIS countries and the concentration of licensing and customs problems in those countries. The broad similarity in the pattern of complaints between CEB and OECD countries is reassuring, with complaints about labour regulation and skill shortages much less in evidence in other country groups.

Moving outside the European and Central Asian transition economies, a first point of comparison is with the work of David Dollar and collaborators (Dollar et al. 2005) in a study using the 'investment climate' surveys for four low income countries (Bangladesh, China, Ethiopia and Pakistan). The authors use 'objective' measures of the business environment collected in surveys similar to the ones we use in this paper, restrict their attention to firms in the garment industry and use city averages as their measure of the quality of the business environment. They estimate a production function, which they augment by including five business environment measures. They conclude that the most significant bottleneck is the delay in getting a phone line, followed by customs delays and power outages. The number of inspections by government officials and the availability of an overdraft do not appear to be as important. The significance they report for delays in getting phone connections is quite at odds with the average subjective assessments of managers as to the problems posed by the telecommunications infrastructure in our data (Fig. 3). All four country surveys are in our dataset, and telecommunications is never recorded as of above average importance (nor is it in any other country in the dataset, as we noted above (Fig. 2)). What are we to make of this discrepancy?

Figure 3. Histograms of Reported Constraints for 6 Country Groups



Fortunately our data cast an interesting light on this question. As we reported in Section 4, the severity of telecoms constraints enters with a large and significant negative coefficient in our between country production function regressions, exactly consistently with the results of Dollar et al. who use the 'objective' reports of delays in getting a phone line in their smaller sample of countries. However, as we discussed above, this negative coefficient is not a justification for interpreting telecoms constraints as being causally responsible for poor growth performance. There are two possible explanations for the discrepancy between the regression results and the low reported costs of the constraints. One is reverse causality – namely, that countries (or cities, in the Dollar et al. analysis) that are prosperous for a variety of other reasons for which it is not realistically possible to control econometrically also happen to have higher levels of telecom services. We have re-estimated our equations using a variety of instrumental variables to try to address this endogeneity problem but have been unable convincingly to do so. Using population density as an instrument for telecoms constraints (on the grounds that it is likely to affect the cost of investing in telecoms infrastructure) does indeed lead to telecoms being no longer significant in the performance regression, but the standard errors are high and the change in the coefficient is not significant at conventional levels. Using urbanization as an instrument, for similar reasons, makes telecoms constraints apparently more important in the performance regression, but we can reject the hypothesis that urbanization is uncorrelated with the performance variable other than through infrastructure, so it is an unsatisfactory instrument as well. Any plausible instrument has to affect telecoms infrastructure but not otherwise to be correlated with economic performance, and we have so far been unable to find instruments that meet this challenging description.

An alternative explanation for the discrepancy could be the presence of network externalities. Our data measure the reported importance of telecoms constraints to telecoms users, not the network benefits that their use of telecoms might have on others. But their direct importance is small. The absolute level of the reported constraint is 1.74 in Pakistan, 1.91 in China, 2.43 in Bangladesh and 2.36 in Ethiopia – unimportant in absolute terms in Pakistan and China and somewhat important in the other two countries. The relative levels show, however, that it is never a priority for any of these countries compared to their other public good constraints. Whether or not network externalities matter remains a subject for further research, but our data suggest they would have to be large in order to overturn the conclusion that telecoms constraints matter little for firm performance.[8] This is in our view a persuasive example of the richness of interpretation that subjective data of this kind make possible, and which warns us of the caution we need to exercise before interpreting results from augmented productivity regressions as corroborating causal hypotheses.

A second point of comparison is with the work of Ayyagari, Demirgüç-Kunt and Maksimovic, 2006, who report on the basis of regression analysis that only constraints related to finance, crime, and political instability[9] are important for firm performance.

[8] There is some evidence that they may indeed be large at some stages of development (see Roeller and Waverman, 2001).

[9] The interpretation of this question appears problematic: the authors of this study refer to 'political instability' whereas the question appears in at least some versions of the survey instrument as 'economic policy uncertainty' or 'regulatory policy uncertainty'.

Other constraints such as taxes and regulations are found to be unimportant, and our framework can help to explain why and to caution against the policy implications they draw. Our findings show that tax rates and tax administration, for instance, are reported as both relatively and absolutely important by firms across the entire sample of countries. In our interpretation that makes it very probable that they are indeed important, in the sense that policies to reduce tax rates while holding other aspects of public good provision constant (for instance by improving administrative efficiency) would improve firm performance. However, constraints that score highly in both rich and poor countries are likely to show up with low values of regression coefficients (as confirmed in Table 2 above), however important they are in fact, because regression analysis picks up *differences* in scores reported by high and low-performance firms. This does not mean, as one might initially suppose, that tax constraints are unimportant, on the grounds that 'if rich countries can maintain high tax rates that means they can hardly matter much for economic performance'. Such an inference would be warranted only if tax rates were exogenous. But if, as seems overwhelmingly likely, countries that perform well demand higher levels of public good provision and have to maintain high tax rates to finance these, then tax rates will not show up in the regressions however important they really are.[10]

6. Using Data on Reported Constraints for Policy Analysis

A number of different approaches have been adopted in the literature for identifying bottlenecks to development and for setting policy priorities. One is to use institutional quality bench-marks from advanced economies (e.g., Zinnes et al., 2002, develop a series of 'competitiveness indicators' for transition economies, which they map on to the World Economic Forum's Global Competitiveness Report series). However, it is not clear how to translate a gap to the bench-mark into policy advice: should resources be devoted to aspects of the institutional environment where the gap to the bench-mark is relatively small or relatively large? Second, a bench-mark approach may neglect technological change and the emergence of private substitutes for public goods. For example, measuring telephone lines per capita or the number of days delay in getting a fixed line telephone connection may have become a poor bench-mark for communications infrastructure as mobile telephony has developed as a substitute for land-lines. Similarly the minimum efficient scale for power generation has shrunk.

Hausmann, Rodrik and Velasco (hereafter HRV, 2005) suggest a procedure for identifying the binding constraint on growth by using a simple growth model to establish a hierarchy of constraints. They then provide a guide to how aggregate indicators can be used to diagnose which constraint binds in a particular country. The key first step in the diagnosis of binding constraints is to distinguish between a situation where a country is constrained by a shortage of finance (low domestic savings, poor access to international finance due to high macroeconomic risk) from one in which a paucity of profitable investment opportunities (due to poor complementary factors; government failures; market failures) rather than inadequate

[10] It has been suggested to us that managers may systematically complain about taxes because managers tend to be politically conservative and high taxes are what conservative people typically complain about. While we cannot rule out this possibility, it would not explain why managers report labour regulations to be unimportant in the great majority of countries, since complaining about labour regulation is also a favourite occupation of the politically conservative.

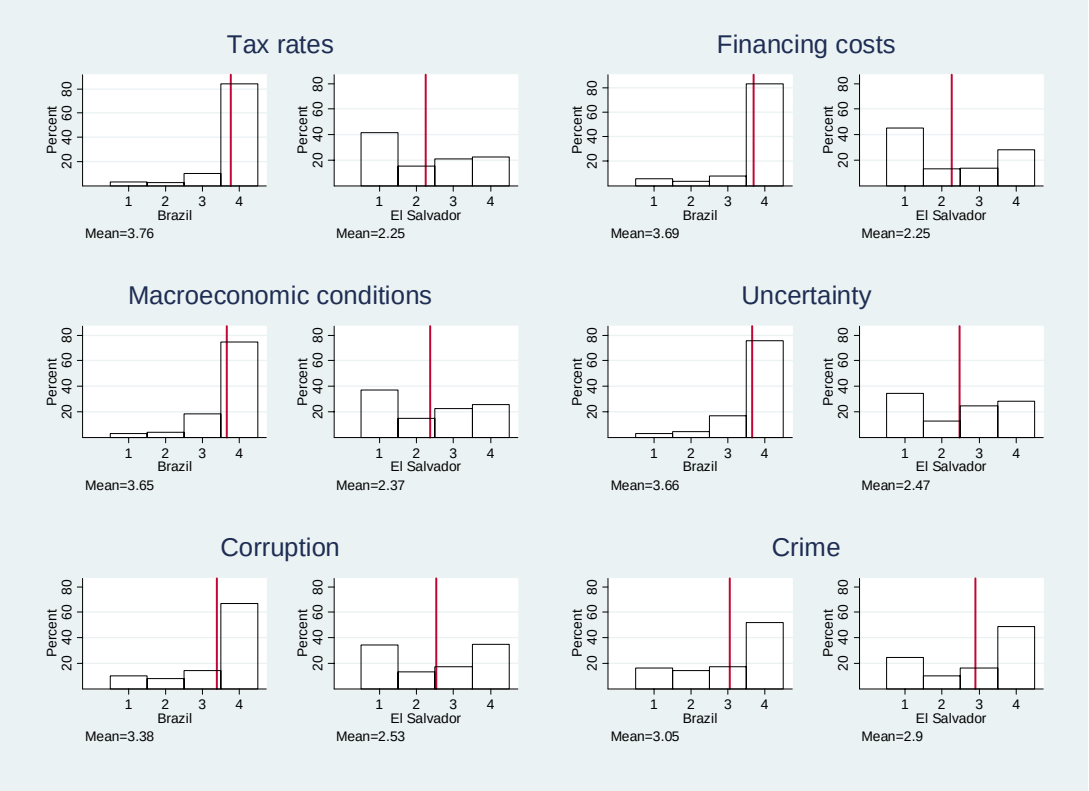
access to finance limits growth. This initial classification is important since diverting resources so as to boost the profitability of investment (by for example improving institutional or physical infrastructure) is wasteful if existing profitable projects cannot secure finance. Equally, efforts to improve the availability of finance are likely to have little impact on growth if good projects are not coming forward.[11] In contrast to a 'laundry list' approach to reform, HRV's growth diagnostics emphasizes that the cost of a constraint depends on the characteristics of the country. However, a shortcoming with their method is that the match between the aggregate proxies for the constraints in the model is assumed and cannot be tested.

It is interesting to compare our data with an example of HRV's growth diagnostics. They look at three Latin American countries, Brazil, El Salvador and the Dominican Republic. The first two are in our data set. Their diagnosis of the binding constraint for Brazil is a lack of finance for the plentiful profitable investment opportunities available – more specifically, the key problems are excessive macroeconomic risk and inadequate domestic savings. According to the ranking of complaints by managers of manufacturing firms in our data set, the biggest problems in Brazil are tax rates, macroeconomic stability and policy uncertainty, and the cost of finance. The histograms in Fig. 4 record the heavy concentration of responses in the 'Major obstacle' category for the macro/finance constraints in the case of Brazil. This is consistent with the high macroeconomic risk and high cost of finance alluded to by HRV. By contrast, HRV find El Salvador to be a puzzling case and suggest that its weak performance is hard to reconcile with the absence of macro imbalances (no shortage of finance) and its good standing in international rankings of institutional quality and infrastructure. They conclude that El Salvador's problem is a lack of appropriate innovation.

When we look at the subjective ratings of managers in manufacturing, we indeed find that managers in El Salvador place much less weight on macroeconomic, tax and finance problems than do managers in Brazil (Fig. 4). This is consistent with the macro data referred to by HRV: El Salvador has plentiful credit available. The cross-country bench-marking indices used by HRV to discriminate between the possible sources of inadequate profitable investment opportunities in El Salvador are of limited use because they have difficulty in identifying priorities for countries (like El Salvador) that have low average constraints. The manager responses in our dataset reveal that their biggest complaints are about crime. As Fig. 4 illustrates, although the mean scores for 'Crime' and 'Corruption' in El Salvador are lower than in Brazil, these constraints are high priority for El Salvador but not for Brazil. The standard errors for the mean responses are small (about 0.02 for the mean Brazilian responses, and about 0.05 for the smaller El Salvadorian sample) relative to the differences in means between the two countries, and all the means in Fig. 4 were statistically different in Brazil and El Salvador at conventional levels.

[11] Bigsten and Söderbom (2006) claim in relation to manufacturing firms in Africa that 'the most likely explanation why lack of credit has not been a major factor in explaining low levels of investment over the last decade is that few firms could identify strong investment opportunities during this period' and the 'reason these reforms [of the financial systems in many African countries in the 1990s] have appeared ineffectual thus far is that the constraints that were relaxed as a result were in fact not binding at the time'.

Figure 4. Identifying Binding Constraints in Brazil and El Salvador



To illustrate more generally the potential usefulness of the survey data for growth diagnostics, in Table 3 we show the top-ranked constraints for each country. This table shows for each country the most important constraint, plus any other constraints that are nearly as important (within 0.1 of the leading constraint). The results are organized according to the decision tree hierarchy of HRV, with the 'macro/finance' constraints on the left and the constraints relating to a lack of profitable investment projects on the right. Countries such as Bangladesh, Latvia or the Philippines that have only one entry (labelled 1) are countries for which one constraint is dominant. Subject to the caveats below and to judgments about its susceptibility to influence by policy and the cost of intervention, this indicator points policy-makers toward prioritizing a specific aspect of the business environment. Countries such as Spain, Chile or Kenya that have several entries in the table, by contrast, are countries where no one single dimension of the business environment is dominant and where policy may therefore need to be more broadly directed.

It is important to emphasize that data of this kind should be seen as complementary to rather than a substitute for other diagnostic indicators. There are a number of caveats to their use. First, the initial distinction between countries constrained by lack of finance versus lack of projects is a macroeconomic one and macro data should be used for the primary diagnosis. Although the manager responses on macro elements can help to confirm the importance of these issues, the data are likely to be contaminated by the effects of the business cycle. Second, the data reported in Table 3 come from manufacturing firms only (although many of the surveys are representative of the entire economy and are therefore available for an economy-wide analysis).

Third, as emphasized in Section 2, manager survey data cannot reveal the priorities affecting potential firms.

In the first part of this paper we argued that the coefficients on constraint variables included in an augmented production function framework cannot be interpreted as providing information on whether or not the variable is a significant determinant of firm performance. Nevertheless, we have provided evidence that the answers to questions about the significance of different constraints contain information. In addition to using this information directly in, for example, a growth diagnostics framework for country policy analysis as discussed above, we undertake a second exercise where we use the manager's assessment of the cost of the constraint as the dependent variable and ask how this varies with firm characteristics. This is useful for the policy-maker because it helps pin down the type of firm that would benefit most from a relaxation of the constraint.

The extent to which weak quality or weak supply of the public good impedes firm performance depends on (a) the existence of substitutes for the public good, (b) the extent of the firm's own resources and (c) the presence of good projects. The existence of substitutes is a characteristic of the public good in question rather than of the firm itself. Firm-level substitutes are available for some elements of the physical and institutional infrastructure. For example, a firm can install its own generator if the grid supply fails; employ its own security staff if the police fail to protect its property; or retreat into the informal sector if taxes are too onerous. The firm cannot provide its own substitute for other elements of the institutional infrastructure such as the macroeconomic environment and customs regulation. In countries where state-owned firms had or have privileged access to the suppliers of public goods, they may have better connections or capture possibilities, which allow them to substitute more easily in the case of some regulations. Similarly small and medium-sized firms (SMEs) would be expected to have less access to these resources.

We therefore regress each of our 'cost of constraint' measures on controls for potential good projects (manager education) and access to constraint-reducing resources / technologies (i.e., foreign owner, state owner, SME). The discussion in the paragraph above gives us a prediction of the signs on these controls: higher access to resources to mitigate constraints should reduce their severity so we predict a negative sign. We also include a measure of performance: if we observe a positive coefficient, then although this may capture aspects of resources and of future prospects, a positive sign nevertheless indicates that 'better' firms are more constrained.

Table 3. Top-ranked Constraints

	Finance constraint			Lack of investment projects													
				Government failure:									Complementary factors				Mkt fail.
				Macro risk		Micro risk											
	Tax rate	Finance cost	Finance access	Macro	Uncertainty	Corruption	Crime	Labour regulation	Customs	Tax admin	Land access	Licensing	Skills	Electricity	Transport	Telecoms	Anticompetitive behaviour
Albania	**2**													**1**			
Algeria			**2**														**1**
Armenia	**2**									**1**							
Azerbaijan	**1**									**2**							
Bangladesh														**1**			
Belarus				**2**	**1**												
BiH		**2**			**1**												
Brazil	**1**	2															
Bulgaria					**1**												
Cambodia						**1**											
Chile				**1**								**3**	**2**				
China	**1**				3								**2**				
Croatia				**1**	**2**												
Czech Rep.	**1**																
Ecuador					**1**												
Egypt	**1**																
El Salvador							**1**										
Eritrea				**1**													
Estonia								**1**					**2**				
Ethiopia	**1**																
FYROM				**2**	**1**												
Georgia					**1**												
Germany	**1**																
Greece	**1**																
Guatemala						**2**	**1**										
Honduras		**3**				**1**	**2**										
Hungary	**1**																
India						**1**											
Indonesia				**1**	**2**												
Ireland	**1**												**2**				
Kazakhstan	**3**	**1**								**2**							
Kenya	**3**	**2**				**1**											
Kyrgyzstan					**2**					**1**							
Latvia	**1**																
Lithuania	**1**																
Madagascar				**1**													

	Finance constraint			Lack of investment projects													
				Government failure:									Complementary factors				Mkt fail.
				Macro risk		Micro risk											
	Tax rate	Finance cost	Finance access	Macro	Uncertainty	Corruption	Crime	Labour regulation	Customs	Tax admin	Land access	Licensing	Skills	Electricity	Transport	Telecoms	Anticompetitive behaviour
Mali		**1**	**2**														
Moldova	**1**																
Mozambique		**1**															
Nicaragua						**1**											
Oman		**2**						**3**					**1**				
Pakistan	**2**	3								**1**							
Philippines				**1**													
Poland	**1**																
Portugal				**1**													
Romania	**2**			**1**													
Russia					**1**					**2**							
Senegal		**1**															
Serb & Mon					**1**												
Slovakia				**1**													
Slovenia					**1**												
South Africa				3				**1**					**2**				
South Korea				**1**													
Spain	**3**		**2**	**4**									**1**				
Sri Lanka														**1**			
Syria	**1**																
Tajikistan	**1**									**2**							
Tanzania	**1**																
Thailand				**1**									**2**				
Turkey	**2**			**1**	**3**												
Uganda		**1**															
Ukraine	**1**			**2**													
Uzbekistan				**1**													
Vietnam						**2**											**1**
Zambia		**2**		**1**													

Note: Means of constraints are for manufacturing firms only. The constraint with the highest mean=1, 2nd highest mean=2, etc. Only constraints with means within 0.1 of highest mean are included. Bold = mean was within 95% confidence interval for the constraint with the highest mean.

Bertrand and Mullainathan (2001) claim that economists' scepticism about the use of subjective survey response data is justified by a consideration of the problem of measurement error. Indeed, they claim 'subjective variables cannot reasonably be used as dependent variables given that the measurement error likely correlates in a very causal way with the explanatory variables' (p.70). The example they give is where the subjective variable is 'attitude toward / preference for money'. They claim that using an income measure as an explanatory variable will be severely biased by the effect of wealth on the attitude *to reporting* preference for money. On the other hand, they argue that if the measurement error is small enough, subjective measures may be helpful in predicting outcomes. In our context, we have explicitly modelled the problem of reverse causality, which affects the interpretation of the coefficient on the subjective constraint variable as a regressor in the within-country regressions (Sections 2 and 3). In contrast to the examples of Bertrand and Mullainathan, the problem of interpreting the findings as causal when the subjective data are used as regressors is especially worrying in our context. Our Lagrangian modelling framework provides an explanation for this and a rationale for using the constraint variable as the dependent variable.

We therefore turn to estimates of the business constraints regression in order to assess how the characteristics of firms are related to managers' assessment of constraints. Our prediction from Section 3 was that the cost of the infrastructure constraint is increasing in firm productivity and performance, while the cost of the finance constraint is ambiguous but likely to be decreasing overall in firm productivity and performance.

As an illustration, in Table 4, we show the coefficients on all the variables for two business environment constraints where there is a sharp contrast between the results: the customs regulations variable and the access to finance variable. The dependent variable is the manager's assessment of the severity of the constraint as an obstacle to the operation and growth of the business. In the first equation, we can see that firms with higher relative efficiency (as measured by the within regression TFP residual[12]) voice the most complaints about the burden imposed by customs regulations. More highly educated managers (who are likely to be associated with higher firm quality) are also more likely to view such regulations as imposing a constraint on the operation and expansion of their business. We also see a pattern repeated for other public goods constraints, where foreign owned firms believe themselves to be more highly constrained and state owned firms less highly constrained than the control group of domestically owned private firms.

By contrast, it is less efficient firms who complain most about access to finance. This is consistent with the results from the comparison of the within and between TFP regressions and indicates that the approach of using the constraints measure as the dependent variable provides a method of identifying the characteristics of firms likely to be most affected by the relaxation of a particular constraint. There is no significant relation between managerial education and reported constraints on access to finance.

[12] More precisely, it is the residual from a Cobb-Douglas production estimated using a within regression; no explanatory variables appear other than capital, labour and country fixed effects.

To check that the results are not dependent purely on our choice of efficiency measure (which is itself a variable generated by our own production function regressions) we compare the results in Table 4a for TFP with results in Table 4b for an alternative measure of efficiency, namely firms' own reported technological level relative to its main competitors on a 3-unit scale (1 = below, 2 = about the same, 3 = above). Though there are many fewer observations using the latter measure, the results are qualitatively unchanged.

Table 4a. Firm efficiency (measured by TFP) and other characteristics determining perceived constraints

	Customs Regulations		Access to Finance	
TFP	0.059**	0.061**	-0.051**	-0.049**
Manager education	0.086**		0.020	
Foreign owned	0.273**	0.267**	-0.270**	-0.331**
State	-0.217*	-0.211*	-0.090	-0.077
SME	-0.255**	-0.288**	0.107**	0.110**
Big city	0.087*	0.122**	0.066	0.088
N (firms)	12,450	16,421	12,736	16,865
N (surveys)	58	93	58	93
N (countries)	50	58	50	58

Table 4b. Firm efficiency (measured by self-reported technological level) and other characteristics determining perceived constraints

	Customs Regulations		Access to Finance	
Tech level	0.071*	0.078**	-0.098**	-0.097**
Manager education	0.099**		0.013	
Foreign owned	0.266**	0.319**	-0.334**	-0.326**
State owned	-0.340**	-0.302**	-0.082	-0.079
SME	-0.266**	-0.336**	0.140*	0.140**
Big city	0.062	0.094	-0.028	-0.029
N (firms)	7,131	7,178	7,659	7,707
N (surveys)	46	46	46	46
N (countries)	41	41	41	41

Note: ** significant at 1%; * significant at 5% † significant at 10%. The omitted category is domestically owned private firms. The dependent variable is the manager's assessment of the severity of the constraint as an obstacle to the operation and growth of the business. Tech level is the firm's own reported technological level relative to its main competitors on a 3-unit scale (1 = below, 2 = about the same, 3 = above). SME is a dummy for small and median sized enterprises. For definitions of the variables, see the data appendix.

Table 5 presents a summary of the results for each business environment indicator. The coefficients on firm and manager quality, where the level of TFP is used as the measure of firm quality are shown in the first two columns. In the third column, we show the firm characteristics (other than those for sector and location) that are significant in the regression for the constraint shown.

Table 5. Summary of coefficients in separate regressions for each constraint or constraint type as the dependent variable

Constraint	TFP	Manager education	Foreign owned	State owned	SME dummy	Big city	N firms	N surveys	N countries
Infrastructure	*0*	+	+	*0*	-	0	12,990	58	50
Finance	-	*0*	-	*0*	+	0	12,644	58	50
Regulation	*0*	+	+	-	-	+	11,506	57	*49*
Telecoms	0	+	+	0	0	0	13,041	58	50
Electricity	0	+	0	-	0	0	13,101	58	50
Transport	0	+	+	0	-	0	13,062	58	50
Land access	0	0	0	0	0	0	12,626	58	50
Tax rates	0	0	0	0	0	+	12,962	57	49
Tax admin.	0	+	+	0	0	+	12,923	57	49
Customs regulations	+	+	+	-	-	+	12,450	58	50
Licences	0	+	+	-	0	0	12,705	57	49
Labour regulation	0	+	+	0	-	+	12,730	57	49
Access to finance	-	0	-	0	+	0	12,736	58	50
Cost of finance	0	0	-	0	0	0	12,736	58	50
Policy uncertainty	0	+	0	-	-	0	12,784	58	50
Macro-economic stability	0	+	0	-	-	0	12,971	58	50
Corruption	0	0	0	-	0	+	12,938	58	50
Crime	0	0	0	-	0	+	12,463	57	49
Labour skills	0	+	0	0	-	+	13,039	58	50
Anticompet. practices	0	+	-	0	0	0	12,437	57	49
Legal system	+	+	*0*	-	*0*	*0*	*6,952*	*48*	*41*
Mafia	*0*	*0*	*0*	-	*0*	*0*	*927*	*27*	*27*
Contract	*0*	*0*	*0*	*0*	*0*	+	*981*	*27*	*27*
Land title	*0*	*0*	*0*	-	*0*	+	*890*	*27*	*27*

Note: The first three rows show the results for composite constraint variables constructed as explained in the data appendix. The bottom four rows show the results for 4 additional constraint variables included in a smaller number of surveys. Significance is defined as the 5% level.

The first column shows that controlling for other firm characteristics, firms with higher efficiency are more constrained by customs regulations and the legal system and less efficient ones by access to finance. More highly educated managers appear more sensitive to a broad range of constraints. As compared with domestically owned private firms, those with a foreign owner appear more sensitive to some constraints including aspects of physical infrastructure and a series of administrative and regulatory institutions. As we would expect, they complain less about access to or the cost of finance. State owned firms rate many constraints as less of an impediment than other firm types, which suggests that improvements in the business environment will

benefit private firms more. Specifically, private firms would be expected to be the greater beneficiaries from a reduction in policy uncertainty and in macroeconomic instability as well as in corruption and crime and from an improvement in the legal system.

In line with our arguments throughout this paper, interpreting the coefficients in the access to finance regression is less straightforward. We find that controlling for efficiency, SMEs complain more about access to finance – a finding that is consistent with many other studies. However, we would caution against drawing the conclusion that access to finance would raise the growth of these firms and should therefore be eased. As we have emphasized, finance is different from the other constraints; bigger complaints by SMEs could reflect a financial system that is poorly equipped for evaluating the projects of small firms, or the existence of a well-functioning financial system that requires collateral and a track record before lending.

7. Conclusions

This paper has had two main scientific aims, one methodological and one substantive. Methodologically we have defended the use of data on the reported severity of business environment constraints on firm performance. The subjective evaluation of constraints by managers may be interpreted as measures of the Lagrange multipliers in a model of production by firms facing supply constraints for public goods and finance, where the former are interpreted as constraints that are common to all firms in a country (though whose cost can vary between firms), while the latter are constraints that will typically vary between firms as well as between countries. We have derived predictions from the model that fit the observed characteristics of these data, suggesting that such data are indeed useful measures of the constraints to development across a wide range of countries. Our results also point to the shortcomings of previous studies using data of this kind, where the significance of business environment measures in firm performance equations is interpreted as providing an accurate indicator of their importance and where the difference between the finance constraint and those with a public good character is overlooked.

Substantively we have used the data to draw conclusions about the relative importance of different constraints on development and how these vary across countries and across firm types. Among the conclusions are that telecoms infrastructure is never an important policy priority for any country (this is contrary to the conclusions of Dollar et al., 2005, but we have suggested that their conclusions are likely to be generated by endogeneity bias in the cross-section regressions, unless large network externality effects are present, which is in principle a testable hypothesis). Transport is important only for some very poor or war-torn countries, and electricity is the only form of physical infrastructure whose failings rank as important for a large group of countries (mainly in Africa and South Asia). Crime and corruption, by contrast, are important in many countries especially in Central and Latin America and weaknesses in the administration of the tax system are of particular importance in the CIS. Labour regulation emerges as a concern for relatively prosperous countries only. Our results suggest that more efficient firms are especially constrained by poorly functioning customs regulations and inadequacies in the legal system and that it is private rather than state-owned firms that are the likely beneficiaries of improvements in macroeconomic stability and policy predictability as

well as in the functioning of the legal system and of reductions in corruption and crime.

In addition to the purely scientific aims of the paper our aim has also been to demonstrate by example the practical simplicity and usefulness of these data for economic policymaking. Table 3, for example, draws on a large amount of data to classify countries in a simple and intuitive way according to the constraints that are of greatest importance. It may be a commonplace that not all countries are the same (or, to adapt Tolstoy, that even if well-governed countries resemble one another, badly-governed countries are badly governed in their own individual way). But it often proves difficult to saying anything that is both specific and scientific about how countries differ; we hope to have shown here that it can be done.

Overall we believe we have shown that data of this kind yield valuable and non-trivial insights into the factors affecting growth of firms across countries, and we look forward to using such data in future research.

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Data Appendix

The full dataset available to us covers almost 53k firms. The data originate in a series of 135 different surveys conducted in 72 countries over the period 1999-2005. There are two different survey series: BEEPS (Business Environment and Economic Performance Survey), conducted by EBRD and the World Bank and covering mostly transition countries, and PICS (Productivity and Investment Climate Survey), conducted by the World Bank and covering both transition and non-transition countries. The measures of productivity level used in the paper (estimated TFP residual, self-reported technological level) are not available in BEEPS 1999, and so these observations were excluded from most of the analysis.

Table A1
Numbers of firms, by year and survey:

Year	PICS	BEEPS 1999	BEEPS 2002	BEEPS 2004	BEEPS 2005	Total
1999	0	4,104	0	0	0	4,104
2000	2,648	0	0	0	0	2,648
2001	926	0	0	0	0	926
2002	7,187	0	6,667	0	0	13,854
2003	12,383	0	0	0	0	12,383
2004	4,549	0	0	3,346	0	7,895
2005	293	0	0	0	10,762	11,055
Total	27,986	4,104	6,667	3,346	10,762	52,865

The database includes firms in 6 relatively wealthy countries, 5 from the EU (Germany, Greece, Ireland, Portugal, Spain) and 1 from East Asia (South Korea). All of these were surveyed as comparators in the BEEPS 2004 and 2005 rounds.

Country income classifications use the World Bank classification of July 2005, which is in turn based on GNI per capita in 2004.

The financial development classification uses the indicators reported in Djankov, McLiesh and Shleifer (2005) (DMS). Four dummy variables are created: (1) =1 if the DMS creditor rights index (0-4) takes the value of 2 or greater, =0 otherwise; (2) the DMS information sharing dummy, used without modification; (3) the DMS private bureau dummy, used without modification; (4) =1 if the DMS contract enforcement days variable is equal or greater than 365, =0 otherwise. The sum of these 4 dummy variables gives us a 0-4 index. A country is classified as "low financial development" if the sum is 0; as "medium" if the sum is 1-2; and as "high" if the sum is 3-4. Three dummy variables for low, medium and high financial development thus defined were interacted with the managerial responses on access to finance and used in the regression referred to in the main text and reported in detail in Table A2.

Table A2. Test for the effect of the level of financial development on the coefficient on Access to Finance constraint in the within regression

Dependent variable: Log Sales	Within (fixed-effects)	
Log K	0.363**	(0.020)
Log L	0.714**	(0.029)
Foreign owned	0.388**	(0.079)
State	-0.332**	(0.125)
New private	0.028	(0.040)
Big city	0.069	(0.041)
Access to Finance*Low Fin. Dev.	-0.005	(0.008)
Access to Finance*Medium Fin. Dev.	-0.043**	(0.014)
Access to Finance*High Fin. Dev.	-0.041**	(0.010)
R-sq (within)	0.7282	
N (firms)	16,282	
N (surveys)	86	
N (countries)	54	

Note: ** significant at 1%; * significant at 5%.
Standard errors (in parentheses) robust to heteroskedasticity and clustering on countries. The omitted category is privatised firms

About 63% of the firms in the database are in manufacturing, about one-third are in services, and the remaining 6% are in construction. An important influence on this mix is the fact that the BEEPS surveys aimed to cover the entire business sector, whereas the PICS covered the manufacturing sector almost exclusively. Most of the results in the paper are based only on manufacturing firms, partly for this reason.

Of the roughly 31k manufacturing firms used in the bulk of the analysis, almost 28k were always private. The remaining firms were roughly evenly divided into privatised firms and SOEs. Most of privatised firms are in the transition countries of CEB, SEE and CIS, whereas the SOEs in the sample are scattered about the globe.

Small and medium-sized enterprises (SMEs) are defined as having employment under 100 persons. These make up about one-third of these manufacturing firms. Significant foreign ownership is defined as a stake of 10% or more in the firm; about 4k of the 31k firms have such stakes. A bit over half of the subset are from a big city, defined as a country capital or a city with a population of more than one million.

Table A3
Full dataset:

	WB Income classif.	DMS finan. devel. classif.	Survey				Of which: excl. BEEPS 1999	
			PICS	BEEPS 1999	BEEPS 2002	BEEPS 2004	BEEPS 2005	Manuf	Other or n.a.
non-TE OECD									
Germany	High	High				1,197		231	966
Greece	High	High				546		103	443
Ireland	High	High					501	181	320
Portugal	High	High				505		134	371
Spain	High	High					606	137	469
Turkey	Up-mid	High		150	514		559	323	750
Total				150	514	2,248	1,666	1,109	3,319
CEE									
Czech	Up-mid	High		149	268		343	157	454
Estonia	Up-mid	n.a.		132	170		219	78	311
Hungary	Up-mid	Mid		147	250		610	419	441
Latvia	Up-mid	High		166	176		205	62	319
Lithuania	Up-mid	Mid	239	112	200		205	253	391
Poland	Up-mid	Mid	108	246	500		975	749	834
Slovakia	Up-mid	Mid		138	170		220	68	322
Slovenia	High	Mid		125	188		223	110	301
Total			347	1,215	1,922		3,000	1,896	3,373
SEE									
Albania	Low-mid	Mid		163	170		204	143	231
BiH	Low-mid	High		192	182		200	147	235
Bulgaria	Low-mid	Mid	548	130	250		300	453	640
Croatia	Up-mid	Mid		127	187		236	119	304
FYROM	Low-mid	Mid		136	170		300	138	332
Kosovo	Low-mid	n.a.	329					77	252
Romania	Low-mid	Mid		125	255		600	468	387
Serbia-Mont.	Low-mid	Mid	910		250		200	552	808
Total			1,787	873	1,464		2,040	2,097	3,189
CIS									
Armenia	Low-mid	Mid		125	171		351	298	224
Azerbaijan	Low-mid	Mid		137	170		350	267	253
Belarus	Low-mid	Mid		132	250		325	97	478
Georgia	Low-mid	Low		129	174		200	85	289
Kazakhstan	Low-mid	Low		147	250		585	419	416
Kyrgyzstan	Low	Mid	102	132	173		202	220	257
Moldova	Low	Mid	103	139	174		350	360	267
Russia	Up-mid	Mid		552	506		599	294	811
Tajikistan	Low	n.a.	107		176		200	215	268
Ukraine	Low-mid	Mid		247	463		594	323	734
Uzbekistan	Low	Low	100	126	260		300	232	428
Total			412	1,866	2,767		4,056	2,810	4,425
LA Carib									
Bolivia	Low-mid	Mid	671					663	8
Brazil	Low-mid	Mid	1,642					1,641	1

	WB Income classif.	DMS finan. devel. classif.		Survey				Of which: excl. BEEPS 1999	
			PICS	BEEPS 1999	BEEPS 2002	BEEPS 2004	BEEPS 2005	Manuf	Other or n.a.
Chile	Up-mid	High	948					758	190
Ecuador	Low-mid	Mid	453					453	
El Salvador	Low-mid	High	465					465	
Guatemala	Low-mid	Mid	455					435	20
Honduras	Low-mid	Mid	450					450	
Nicaragua	Low	High	452					452	
Peru	Low-mid	Mid	576					553	23
Total			6,112					5,870	242
East Asia									
Cambodia	Low	Low	503					133	370
China	Low-mid	Mid	3,948					2,629	1,319
Indonesia	Low-mid	Mid	713					713	
Philippines	Low-mid	Mid	716					716	
South Korea	High	High				598		225	373
Thailand	Low-mid	Mid	1,385					1,385	
Vietnam	Low	Mid				500		261	239
Total			7,265			1,098		6,062	2,301
South Asia									
Bangladesh	Low	Mid	1,001					1,001	
Bhutan	Low	n.a.	98					56	42
India	Low	Low	2,722					2,719	3
Nepal	Low	Mid	223					223	
Oman	Up-mid	Low	337					99	214
Pakistan	Low	Mid	965					914	51
Sri Lanka	Low-mid	n.a.	452					451	
Syria	Low-mid	Mid	560					549	8
Total			6,358					6,012	318
Africa									
Algeria	Low-mid	Low	557					475	82
Egypt	Low-mid	Mid	977					977	
Eritrea	Low	n.a.	79					70	9
Ethiopia	Low	Mid	427					427	
Kenya	Low	High	284					265	19
Madagascar	Low	Mid	293					292	1
Mali	Low	Mid	155					135	20
Morocco	Low-mid	Mid	859					859	
Mozambique	Low	Mid	194					194	
Nigeria	Low	Mid	232					212	
Senegal	Low	Mid	262					238	23
South Africa	Up-mid	High	603					584	13
Tanzania	Low	Mid	276					265	11
Uganda	Low	Mid	300					260	40
Zambia	Low	Mid	207					179	10
Total			5,705					5,432	228
Grand total			27,986	4,104	6,667	3,346	10,762	31,288	17,395

Table A4
Manufacturing firms only; BEEPS 1999 excluded.

	Total	Ownership			Ownership		Firm size		Location	
		Privat-ised	State	New private	Dom.	For.	Large	SME	Large city	Small city or rural
non-TE OECD										
Germany	231	4	8	219	189	42	63	168	15	216
Greece	103	3		100	97	6	27	76	45	58
Ireland	181			181	148	33	38	143	43	138
Portugal	134	3	1	130	112	22	53	81	15	119
Spain	137			137	122	15	34	103	28	109
Turkey	323	6	31	286	277	46	83	240	124	199
Total	1,109	16	40	1,053	945	164	298	811	270	839
CEE										
Czech	157	30	11	116	132	25	43	114	24	133
Estonia	78	14	5	59	60	18	21	57	39	39
Hungary	419	73	9	337	329	90	100	319	147	272
Latvia	62	22	1	39	36	26	24	38	29	33
Lithuania	253	46	10	197	212	41	63	189	87	166
Poland	749	76	30	643	699	50	113	636	87	662
Slovakia	68	14	10	44	55	13	34	34	17	51
Slovenia	110	47	8	55	81	29	56	54	11	99
Total	1,896	322	84	1,490	1,604	292	454	1,441	441	1,455
SEE										
Albania	143	16	7	120	114	29	31	112	34	109
BiH	147	37	24	86	132	15	51	96	39	108
Bulgaria	458	180	15	263	391	65	146	305	137	319
Croatia	119	37	18	64	106	13	39	80	41	78
FYROM	138	36	28	74	125	13	68	70	59	79
Kosovo	77	1		76	76	1		77		77
Romania	468	66	24	378	399	69	124	344	66	402
Serbia-Montenegro	552	92	168	292	517	35	216	336	146	406
Total	2,102	465	284	1,353	1,860	240	675	1,420	522	1,578
CIS										
Armenia	298	102	20	176	260	38	52	246	195	103
Azerbaijan	267	20	46	201	224	43	78	189	187	80
Belarus	97	9	13	75	66	31	36	61	38	59
Georgia	85	38	7	40	67	18	29	56	19	66
Kazakhstan	419	96	29	294	381	38	97	322	148	271
Kyrgyzstan	220	77	16	127	176	44	78	142	93	127
Moldova	360	110	18	232	303	57	109	251	176	184
Russia	294	77	30	187	254	40	121	173	154	140
Tajikistan	215	59	27	129	196	19	61	154	87	128
Ukraine	323	60	35	228	272	51	80	243	108	215
Uzbekistan	232	48	19	165	158	74	72	160	93	139
Total	2,810	696	260	1,854	2,357	453	813	1,997	1,298	1,512
LA Carib										
Bolivia	663	12		651	614	49	68	376	n.a.	n.a.
Brazil	1,641	8	2	1,631	1,554	87	455	1,180	465	1,175

	Total	Ownership			Ownership		Firm size		Location	
		Privat-ised	State	New private	Dom.	For.	Large	SME	Large city	Small city or rural
Chile	758		9	749	653	123	265	493	439	319
Ecuador	453	2	2	449	397	56	83	356	357	92
El Salvador	465	3	1	461	426	39	97	368	201	85
Guatemala	435	1		434	395	40	95	340	310	125
Honduras	450	5		445	379	71	108	342	92	358
Nicaragua	452	15	7	430	407	45	36	416	189	263
Peru	553			553	505	48	14	108	462	91
Total	5,870	46	21	5,803	5,312	558	1,221	3,979	2,515	2,508
East Asia										
Cambodia	133	1		132	80	53	58	75	85	48
China	2,629	24	511	2,094	1,974	631	1,380	1,093	2,230	399
Indonesia	713	2	14	697	597	116	362	349	n.a.	n.a.
Philippines	716	28		688	523	166	251	415	104	606
South Korea	225			225	193	32	58	167	117	108
Thailand	1,385	1	1	1,383	1,026	358	796	589	513	206
Vietnam	261	13	27	221	230	31	69	192	126	135
Total	6,062	69	553	5,440	4,623	1,387	2,974	2,880	3,175	1,502
South Asia										
Bangladesh	1,001	46	1	954	959	29	634	349	1,001	
Bhutan	56	5	6	45	54	1	12	43	16	40
India	2,719	53	43	2,623	2,618	63	485	2,159	2,147	572
Nepal	223	5	1	217	208	14	99	124	95	128
Oman	123	2		121	103	19	1	121	14	41
Pakistan	914	10	8	896	902	12	89	822	608	306
Sri Lanka	452	52	52	348	363	87	227	195	109	343
Syria	552	8		544	537	7	44	506	n.a.	n.a.
Total	6,012	181	111	5,748	5,774	232	1,666	4,224	3,990	1,430
Africa										
Algeria	475	11	48	416	464	5	58	400	n.a.	n.a.
Egypt	977	23	15	939	938	39	187	790	482	200
Eritrea	70	23	12	35	63	7	14	56		70
Ethiopia	427	30	57	340	399	20	81	343	203	216
Kenya	265	11	14	240	219	43	68	169	166	99
Madagascar	292	5	8	279	179	112	89	203	192	88
Mali	135	7	13	115	108	26	15	116	124	11
Morocco	859	3	1	855	685	174	302	554	570	191
Mozambique	194	66	1	127	154	36	33	107	119	74
Nigeria	232	2	7	223	131	99	118	102	232	
Senegal	239	4	4	231	181	57	41	195	233	6
Tanzania	265	39	9	217	206	54	48	205	189	76
Uganda	260	16	5	239	200	59	30	230	n.a.	n.a.
Zambia	197	29	5	163	138	59	72	116	115	82
Total	5,477	164	158	2,728	4,544	901	1,437	3,886	3,167	1,161
Grand total	31,366	2,065	1,554	27,747	26,989	4,227	9,538	20,658	15,378	11,985

The range and compatibility of business constraint questions varied from survey to survey. We use a basic set of 17 business constraints that are all available for 66 countries; the subset of manufacturing firms for these countries (and excluding BEEPS 1999) amounted to more than 34k firms, and were the basis for the results reported Figures 3a and 3b. (The missing countries in these figures are Algeria, Bhutan, Bolivia, Egypt, Morocco, Mozambique, Nepal, Nigeria, Peru, and Syria; all except Bolivia have data on a subset of these 17.) There are an additional 4 business constraints for which data are available for 29-52 countries.

Table A5

	No. firms		No. countries	No. surveys
	All	Manuf. (excl. BEEP 1999)		
Basic set (17)				
Telecoms	43,323	27,007	70	106
Electricity	43,551	27,144	70	106
Transport	42,816	26,589	69	105
Land access	40,981	25,372	67	103
Tax rates	46,265	25,955	66	127
Tax admin	46,044	25,851	66	127
Customs	43,212	24,664	69	130
Licensing	45,408	25,487	66	127
Labour regs.	45,719	25,604	66	127
Fin. Access	41,220	25,470	66	102
Fin. Cost	45,488	25,752	67	128
Uncertainty	45,843	25,845	66	127
Macro	45,919	25,865	66	127
Corruption	45,007	25,805	68	128
Crime	44,182	24,506	65	126
Skills	42,698	26,501	67	103
Anti-comp. practices	44,861	25,240	66	127
Additional (4)				
Legal	34,037	15,802	52	112
Mafia	23,047	6,409	34	86
Contract violations	16,748	5,726	29	56
Land title	18,972	6,335	34	61

The combined (i) infrastructure, (ii) regulation and (iii) finance constraints were constructed using the first principal component of (i) telecoms, electricity and transport, (ii) customs, licensing, regulation and uncertainty, and (iii) access to and cost of finance, respectively. These indexes were normalised to take the same range as the raw indexes (1-4).

Productivity levels are defined for manufacturing firms using TFP residuals or the firms' self-reported technological level. TFP residuals could be calculated for about 18k firms. For the purposes of the figures, firms were classified into low/medium/high TFP categories based cutoffs for the residuals of +/ 0.4, i.e., 40% above or below the average; these cutoffs defined three groups of about 6k firms each. TFP in levels is based on sales and capital in US dollars and on total employment. In the BEEPS surveys, sales and fixed capital are estimated by the interviewee (typically a member of the senior management of the firm); in the PICS surveys, these are based on accounting data in local currency, converted using current exchange rates. Since

movements in the US dollar exchange rate and domestic US inflation affect our chosen numeraire, we adjusted these figures in current dollars using the US Federal Reserve's index of the real foreign exchange value of the dollar and the US Bureau of Economic Analysis' GDP deflator. The result is values for sales and fixed capital that are, roughly speaking, in constant US dollars.

Self-reported technological level is based on the answer to a question asking the interviewee to think of the main product line/production process of the firm and to compare it to that of "your closest competitor". Three responses were possible, based on whether the interviewee thought the firm's technology was less advanced/about the same/more advanced than that of its main competitor. Responses are available for only 9,000 firms in the PICS and BEEPS 2002 surveys; 55% rated their technological level at about the same as their main competitor, 20% as below, and 25% as above.

Managerial education is a categorical variable ranging from 1 (didn't complete secondary school) to 6 (has a postgraduate qualification such as an MA or PhD). The distribution for manufacturing firms (again excluding BEEPS 1999) is reported below.

Table A6

Education level	Number	Percent
Below secondary	1,409	6.35
Secondary	3,194	14.40
Vocational	1,316	5.93
Some university	1,983	8.94
University	11,434	51.55
Postgraduate	2,844	12.82
Total	22,180	100.00