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Measuring Competitiveness at the Subnational Level: The Case of 37 Nigerian States

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Abstract

The purpose of this paper is to present a new approach to estimate competitiveness at the subnational level and identify the most important policy reforms likely to foster competitiveness in a locality. The model builds on the literature that links competitiveness to productivity and exploits a number of design features of composite indicators that allow for: (a) modeling the latent and multidimensional nature of competitiveness, (b) rewarding the most progress in policy areas where performance is worse, and (c) ensuring that the composite indicator is not driven by data availability. The methodology is applied to estimate the competitiveness ranking among 37 Nigerian states. The same structural model is then used to simulate the effects of policy reforms and to identify, for each state, the three reforms with the highest impact on the country's competitiveness standing. The ultimate purpose of this method is to spark a healthy debate at the subnational and national levels regarding the most important reforms needed to improve competitiveness and contribute to the productivity growth of the private sector in economies around the world.

Although seemingly intuitive, the term competitiveness is conceptually vague and open to multiple interpretations.[1] Coined as a microeconomic concept but later adopted by macro economists, the term competitiveness has been:

1. defined from different dimensions (products, companies, industries, subnational economies, national economies, and regional blocks);

2. associated to different concepts, such as: (a) standard of living (e.g., Singapore is said to be competitive because of its high income per capita) (Krugman, 1994), (b) attributes of economic growth (productivity, export, technology) (European Commission, 2010; Hall & Jones, 1999; Miozzo & Walsh, 2006; Porter, 1990; Porter, Delgado, Ketels, & Stern, 2008; World Economic Forum, 2009), and (c) location-specific conditions (low wages, low unit labor cost) (De Broeck, Guscina, & Mehrez, 2012; Di Mauro & Forster, 2008); and

3. viewed from different perspectives as a short-term phenomenon (e.g., exchange rate) (Neary, 2006) or as a long-term structural factor (e.g., productivity) (Fagerberg, Srholec, & Knell, 2007; Hall & Jones, 1999; Lewis, 2005; World Economic Forum, 2013).

These different definitions and interpretations of competitiveness generated confusion and have obstructed the development of a consistent framework to explain the determinants of this particular economic phenomenon.

The purpose of this paper is to present a new method to measure competitiveness at the macro level and to use it to prioritize policy reforms. In line with most of the literature, the definition of competitiveness that is adopted is one that associates it to the concept of productivity. Furthermore, we recognize that productivity and competitiveness are determined by location-specific characteristics of the business environment and, cognizant of the multidimensional nature of this phenomenon, we design a composite indicator to measure it. Finally, we apply it to 37 Nigerian states, and we use the model's structural framework to identify the three policy reforms with the highest impact on state-level competitiveness.

A number of composite indicators of competitiveness can be found in the literature; the most often cited are the World Economic Forum's Global Competitiveness Index (GCI), the International Institute for Management Development's World Competitiveness index, and Porter's Competitiveness Index.[2] The index used in this study is significantly different from those because: (a) it measures competitiveness at the subnational level, (b) it allows for nonconstant compensability of indicators, and (c) it is able to prioritize among policy reforms.

Defining Competitiveness

In many countries around the world, policymakers include national competitiveness as one of the central objectives of their economic policies. Of the two most commonly accepted definitions of competitiveness at the macro level, one refers to the ability of an economy to export, and the other refers to its level of productivity. The latter was chosen because associating this concept simply with export growth can be misleading because countries can mask their true level of competitiveness by manipulating exchange rate policies that have nothing to do with the underlying level of efficiency of the production structure (Boltho, 1996).[3] Furthermore, productivity is in itself the underlying determinant of export growth (Alcala & Ciccone, 2004; Hickman, 1992; Kunst & Marin, 1989; Melitz, 2003; Stanovnik & Kovačič, 2000). Additionally, because location shapes the ability of firms to compete in global markets (Farole, Reis, & Wagle, 2010), we postulate that competitiveness is achieved by entrepreneurs exploiting sources of comparative advantages that are unique to the business environment of a specific locality. In line with these arguments, the framework presented in this paper attempts to model this phenomenon through a Subnational Business Competitiveness Index (SBCI).

The Subnational Business Competitiveness Index

The SBCI is designed to help reach three main objectives. Given the multidimensional and latent nature of competitiveness, the first objective is to construct an index able to combine into a single indicator variables measuring completely different phenomena such as access to credit and internet usage. The second objective is to design an index that does not allow constant compensability among indicators, namely, an index that is not equally impacted by progress in one indicator where performance is better compared to an equivalent improvement in another indicator where performance is worse.[4] The final objective is to build an index able to prioritize among indicators, namely, able to assign different weights to different indicators.

The construction of the SBCI requires attention to three main methodological challenges: (a) identifying the individual indicators that characterize competitiveness; (b) determining what aggregation method to use, including, crucially, which weights to adopt; and (c) demonstrating the robustness of the composite indicator.

Selection of Individual Indicators of Competitiveness

The choice of individual indicators used to build the index is driven in part by theoretical considerations and in part by data availability. First, given the definition of competitiveness used, the literature on microeconomic determinants of productivity drives the selection of such indicators. This literature is extensive, and it would be beyond the scope of this paper to summarize it. For the purpose of this paper, the focus falls on those microeconomic factors that are related to the following location-specific determinants of productivity:

1. Physical infrastructure (Aterido & Hallward-Driemeier, 2010; Aterido, Hallward-Driemeier, & Pages, 2011; Calderon & Serven, 2004; Clarke, 2013; Dinh, Mauvridis, & Nguyen, 2012; Dollar, Hallward-Driemeier, & Mengistae, 2005; Fernandes, 2008; Garcia-Milà, McGuire, & Porter, 1996; Gelb, Ramachandran, Shah, & Turner, 2006; Gramlich, 1994; Harrison, Yifu, & Xu, 2011; Li, Mengistae, & Xu, 2011);

2. Access to credit (Aghion, Howitt, & Mayer-Foulkes, 2005; Ang, 2008; Bernstein & Nadiri, 1993; Easterly & Levine, 2001; Gatti & Love, 2006; King & Levine, 1993; Levine, 2005; Maurel, 2001; Rajan & Zingales, 1998; Schiantarelli & Sembenelli, 1999);

3. Skills of the workforce (Barro, 2002; Barro & Lee, 2010; Cohen & Soto, 2007; Coulombe, Tremblay, & Marchand, 2004; De la Fuente, 2011; De la Fuente & Doménech, 2006; Gennaioli, La Porta, Lopez-de-Silanes, & Shleifer, 2011; Hanushek & Kimko, 2000; Hanushek & Woessmann, 2008, 2009; Krueger & Lindahl, 2001); and

4. Quality of institutions (Acemoglu, Johnson, & Robinson, 2001; Campos, Dimova, & Saleh, 2010; Escribano & Guasch, 2005; Fagerberg, 1988; Fisman & Svensson, 2007; Furman, Porter, & Stern, 2002; Keefer & Knack, 1997; Mauro, 1995; Safavian, Graham, & Gonzalez-Vega, 2001; Svensson, 2003).

Findings of this extensive literature indicate that the level of competitiveness in a location is a function of a host of factors that can be grouped into three broad categories: infrastructure, inputs, and institutions.[5]

As with every empirical method, data availability determines the final list of indicators used. For this study, the World Bank's comprehensive firm-level data collection known as the Enterprise Survey data[6] was used. This dataset includes interviews with a representative sample of over 5000 Nigerian entrepreneurs in both manufacturing and services in all 37 states, including the capital city. The data were collected in two rounds, in 2007 and 2009, but the adoption of a standardized methodology made comparison across states possible and meaningful.

The theoretical model leads to 41 variables covering different aspects of the productive structure ranging from ownership of a generator to International Standardization Organization (ISO) certification.[7] An important distinction is made between indicators of costs and of quality. Cost indicators refer to variables measuring objective characteristics, while quality indicators refer to variables measuring perceptions.[8] Both types of data are reliable indicators of the productivity performance of a locality. Furthermore, at times, some proxies cannot be assessed with cost indicators, and hence perceptions are the only data available. Table 1 provides a description of the variables identified. These are grouped into three categories and two dimensions resulting in six groups measuring the cost and quality of infrastructure services, of input markets, and of institutions. Table 2 provides the basic statistics of these indicators.[9]

Table 1
List of Indicators Used in the Construction of the Index

Infrastructure	
Cost	Quality
1 Size of inventory (transport quality)	1 Electricity constraint
2 Power outages: hours per shift	2 Transport constraint
3 Power outages: losses (% of sales)	3 Access to land constraint
4 Own generator (share of firms)	
5 Electricity from own generator (%)	
6 Own transportation (share of firms)	
7 Use of own transportation (% of sales)	
Inputs	
Cost	Quality
1 Sales sold on credit (%)	1 Access to finance constraint
2 Sales as intermediate products (%)	2 Cost of finance constraint: Short term
3 Inputs paid before delivery (%)	3 Inadequately educated workforce constraint
4 ISO certification (share of firms)	
5 Workforce absenteeism: HIV/AIDS	
6 Share of long term financing (equity)	
7 Share of firms with loan	
8 Share of firms that need a loan but do not apply	
9 Workforce absenteeism: Malaria	

	Institutions	
Cost		**Quality**
1 Degree of competition	1	Customs constraint
2 Losses due to theft (% of sales)	2	Crime constraint
3 Bribes for government contract (% of value)	3	Corruption constraint
4 Electric connection days	4	Licensing & permits constraint
5 Visits by tax officials	5	Tax rates constraint
6 Tax evasion (% of sales)	6	Tax administration constraint
7 Customers' purchase orders in writing	7	Functioning of courts constraint
8 Cost of state regulations	8	Political environment constraint
9 Cost of federal regulations	9	Labor regulations constraint
	10	Practise of informal sector constraint

Note. Human immunodeficiency virus / acquired immune deficiency syndrome (HIV/AIDS).

Table 2

Basic Statistics of Variables Used to Build the SBCI

Variable	Obs.	Mean	Std. Dev.	Min	Max
Size of inventory (transport quality)	37	11.72	4.01	5.41	21.92
Power outages: hours per shift	37	0.53	0.12	0.34	0.77
Power outages: losses (% of sales)	37	6.83	2.50	2.60	13.01
Own generator (share of firms)	37	0.81	0.08	0.67	0.96
Electricity from own generator (%)	37	65.66	10.53	44.82	86.52
Own transportation (share of firms)	37	0.41	0.14	0.08	0.73
Use of own transportation (% of sales)	37	61.30	16.92	20.61	85.70
Sales sold on credit (%)	37	12.13	5.48	3.03	24.81
Sales as intermediate products (%)	37	93.04	4.99	80.28	98.51
Inputs paid before delivery (%)	37	29.56	12.80	5.33	59.72
ISO certification (share of firms)	37	0.93	0.07	0.67	1.00
Workforce absenteeism: HIV/AIDS	37	0.02	0.02	0.00	0.06
Share of long term financing (equity)	37	99.98	0.08	99.56	100.00
Share of firms with loan	37	97.49	1.65	96.03	99.99
Share of firms that need a loan but do not apply	37	0.73	0.11	0.49	0.96
Workforce absenteeism: Malaria	37	0.51	0.16	0.20	0.82
Degree of competition	37	98.65	0.22	97.68	98.97
Losses due to theft (% of sales)	37	0.80	0.42	0.19	1.74
Bribes for government contract (% of value)	37	6.99	2.51	2.53	14.09
Electric connection days	37	15.64	12.54	4.24	57.84
Visits by tax officials	37	3.67	1.01	2.05	6.45
Tax evasion (% of sales)	37	70.30	10.76	39.25	84.96
Customers' purchase orders in writing	37	33.02	16.49	1.63	60.61
Cost of state regulations	37	2.39	1.01	0.62	4.67
Cost of federal regulations	37	1.54	0.80	0.22	3.99
Electricity constraint	37	0.76	0.11	0.48	0.92
Transport constraint	37	0.32	0.10	0.08	0.50
Access to land constraint	37	0.18	0.10	0.03	0.46
Access to finance constraint	37	0.44	0.16	0.05	0.77
Cost of finance constraint: Short term	37	0.18	0.08	0.04	0.41
Inadequately educated workforce constraint	37	0.05	0.06	0.00	0.35
Customs constraint	37	0.02	0.02	0.00	0.08
Crime constraint	37	0.11	0.06	0.02	0.26
Corruption constraint	37	0.14	0.10	0.02	0.43
Licensing & permits constraint	37	0.06	0.05	0.01	0.26
Tax rates constraint	37	0.25	0.13	0.05	0.52
Tax administration constraint	37	0.09	0.08	0.01	0.28

Variable	Obs.	Mean	Std. Dev.	Min	Max
Functioning of courts constraint	37	0.00	0.01	0.00	0.03
Political environment constraint	37	0.07	0.04	0.02	0.20
Labor regulations constraint	37	0.04	0.04	0.00	0.16
Practise of informal sector constraint	37	0.10	0.06	0.03	0.29

Aggregation Method

The aggregation method includes three design features related to: (a) modeling the latent nature of competitiveness, (b) assembling the individual elements of the composite index, and (c) weighting.

Modeling the latent nature of competitiveness:

First, because competitiveness is a latent phenomenon, it is necessary to employ a technique that combines different individual indicators into a composite index. The principal component technique was chosen because it presents a number of useful features.[10] First, it allows for combining variables measured differently, helping to model the multidimensionality of competitiveness. Secondly, it generates an estimate of the latent dimension of competitiveness – so-called factors – as a linear combination of the individual indicators. Thirdly, it estimates the share of variability explained by each linear combination (factor), allowing the use of this information as weights.

Assembling individual indicators:

Secondly, two main approaches can be used to assemble different elements into composite indicators, linear and geometric (Organisation for Economic Co-operation and Development [OECD], 2008). With a linear method, compensability is constant: A shortcoming in one indicator is compensated by an equal surplus in the other after accounting for weights. With geometric aggregation, in contrast, a shortcoming in one indicator is compensated by a higher than equal surplus in the other after accounting for weights.

The choice of which approach to adopt was determined by the ultimate objective of the index: to provide policy makers with a tool to identify areas of intervention that would improve the competitiveness standing of a locality the most. In doing so, however, it was necessary to avoid this tool being used to increase the ranking of a locality by simply improving indicators that are already performing relatively well. In other words, the objective was to enable localities to receive a higher ranking when improving poorly performing indicators rather than those that are doing relatively well. In line with this objective, geometric aggregation was chosen so as to give more weight to improvement of those indicators with the lowest scores.

Explicit and implicit weighting:

Last, a nontrivial decision on weighting had to be made. Different approaches can be found in the literature, ranging from statistical methods (regression analysis, factor analysis, etc.), through expert opinions, to data quality (OECD, 2008). In this case, given the absence of any theoretical model to justify such choice,[11] the decision was to let the data determine which variables are more important in the estimation of the competitiveness index by using as weights the explained variance of the retained factors of the principal component estimation.

A final consideration had to be paid to implicit weighting. At times, indices are erroneously presented as unweighted simply because no explicit weight is adopted, while the relative importance of some variables or group of variables is not properly taken into account. This happens when, for example, all available variables are pooled into the generation of an index without giving consideration to their number. In this case, for example, if one specific aspect (e.g., infrastructure) is measured by more variables than another aspect (e.g., education), pooling them into an index will unduly give more weight to those characteristics for which information is more readily available.[12]

To avoid this pitfall, the SBCI was constructed by means of a series of three separate aggregations. In the first stage, the individual indicators for each of the six groups in Table 1 (infrastructure cost, infrastructure quality, inputs costs, inputs quality, institutions costs, and institutions quality) were aggregated into one composite indicator, using principal component and geometric aggregation (see Figure 1).
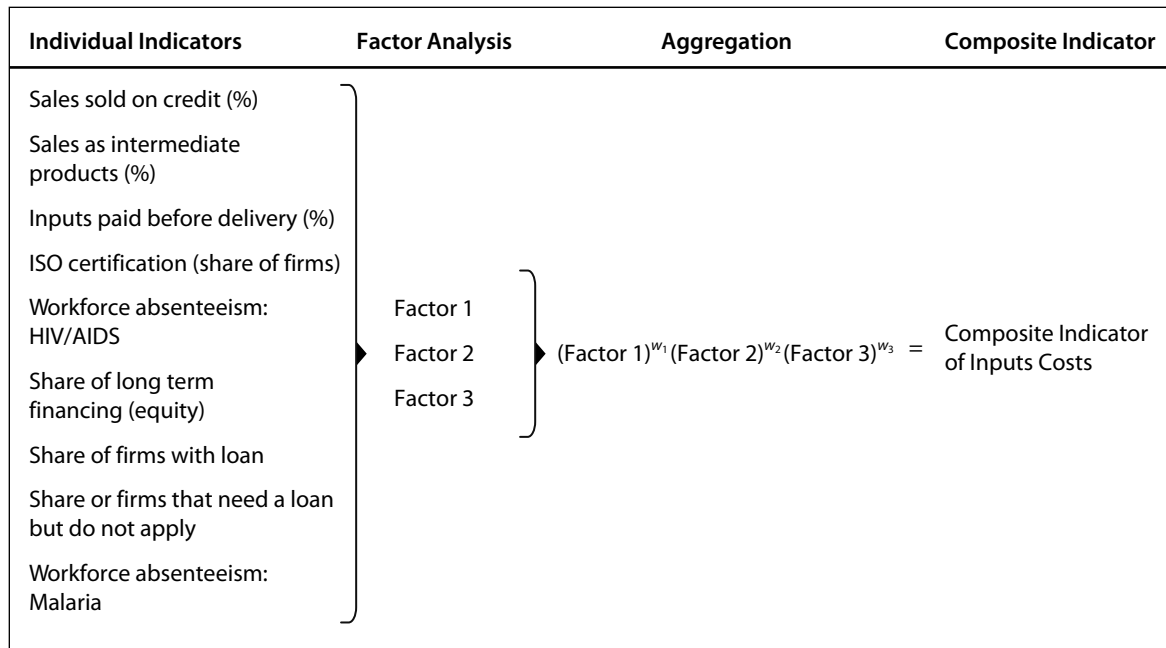
Individual Indicators	Factor Analysis	Aggregation	Composite Indicator
Sales sold on credit (%) Sales as intermediate products (%) Inputs paid before delivery (%) ISO certification (share of firms) Workforce absenteeism: HIV/AIDS Share of long term financing (equity) Share of firms with loan Share or firms that need a loan but do not apply Workforce absenteeism: Malaria	Factor 1 Factor 2 Factor 3	$(\text{Factor 1})^{w_1}(\text{Factor 2})^{w_2}(\text{Factor 3})^{w_3} =$	Composite Indicator of Inputs Costs

Figure 1. Graphic representation of Stage 1 of the aggregation process.

where $w_i =$ share of variance explained by each factor.[13]

Then, the same logic was applied in the second stage of aggregation. The main assumption was that cost and quality of infrastructure, inputs, and institutions are equally important to determine the sub-index of infrastructure, inputs, and institutions, respectively. Hence, these six composite indicators were aggregated into three sub-indices, one for each category: infrastructure, inputs, and institutions, again using principal component and geometric aggregation. As mentioned earlier, in the aggregation process, no weighting was assumed; instead, the weights generated by the principal component method[14] were used (see Figure 2).

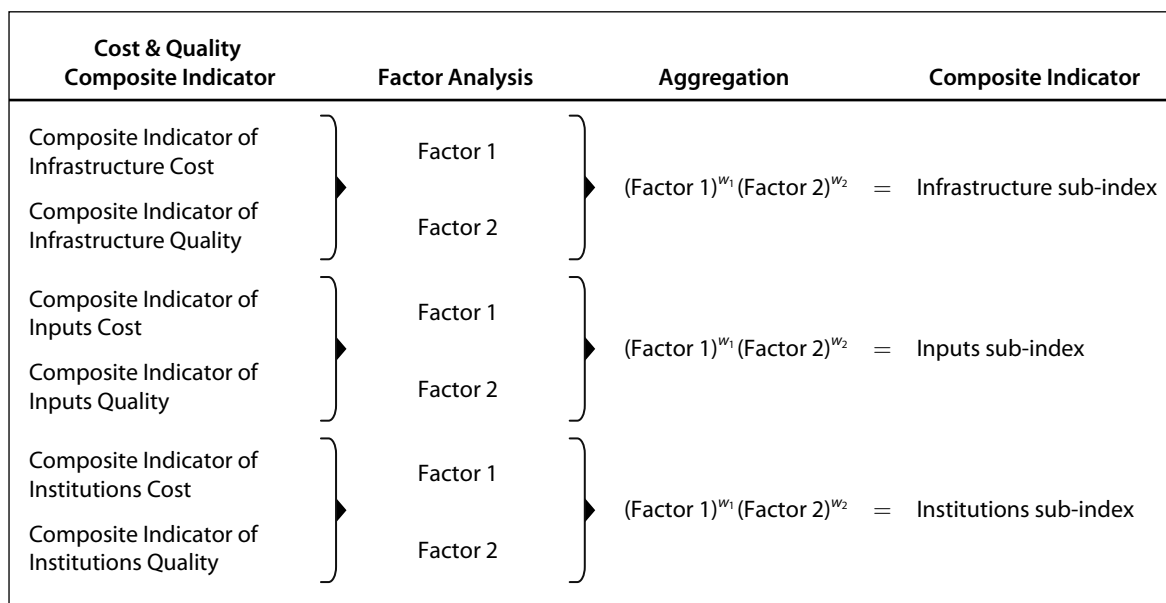| Cost & Quality Composite Indicator	Factor Analysis	Aggregation	Composite Indicator
Composite Indicator of Infrastructure Cost Composite Indicator of Infrastructure Quality	Factor 1 Factor 2	$(\text{Factor 1})^{w_1}(\text{Factor 2})^{w_2} =$	Infrastructure sub-index
Composite Indicator of Inputs Cost Composite Indicator of Inputs Quality	Factor 1 Factor 2	$(\text{Factor 1})^{w_1}(\text{Factor 2})^{w_2} =$	Inputs sub-index
Composite Indicator of Institutions Cost Composite Indicator of Institutions Quality	Factor 1 Factor 2	$(\text{Factor 1})^{w_1}(\text{Factor 2})^{w_2} =$	Institutions sub-index

Figure 2. Graphic representation of Stage 2 of the aggregation process.

Finally, in the last stage, the three sub-indices were aggregated into the SBCI using the same approach (see Figure 3).
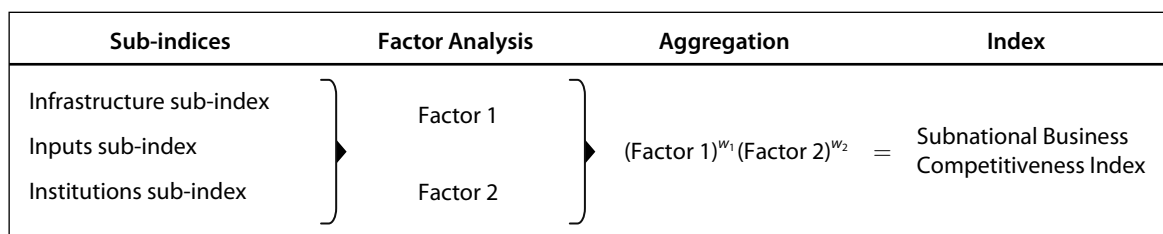
Sub-indices	Factor Analysis	Aggregation	Index
Infrastructure sub-index Inputs sub-index Institutions sub-index	Factor 1 Factor 2	$(Factor\ 1)^{w_1}(Factor\ 2)^{w_2}\ =$	Subnational Business Competitiveness Index

Figure 3. Graphic representation of Stage 3 of the aggregation process**.**

Figure 4 shows a synoptic view of the aggregation framework followed to build the SBCI, indicating the three steps needed to move from the individual indicators to six composite indicators, to three sub-indices, and finally to the SBCI.
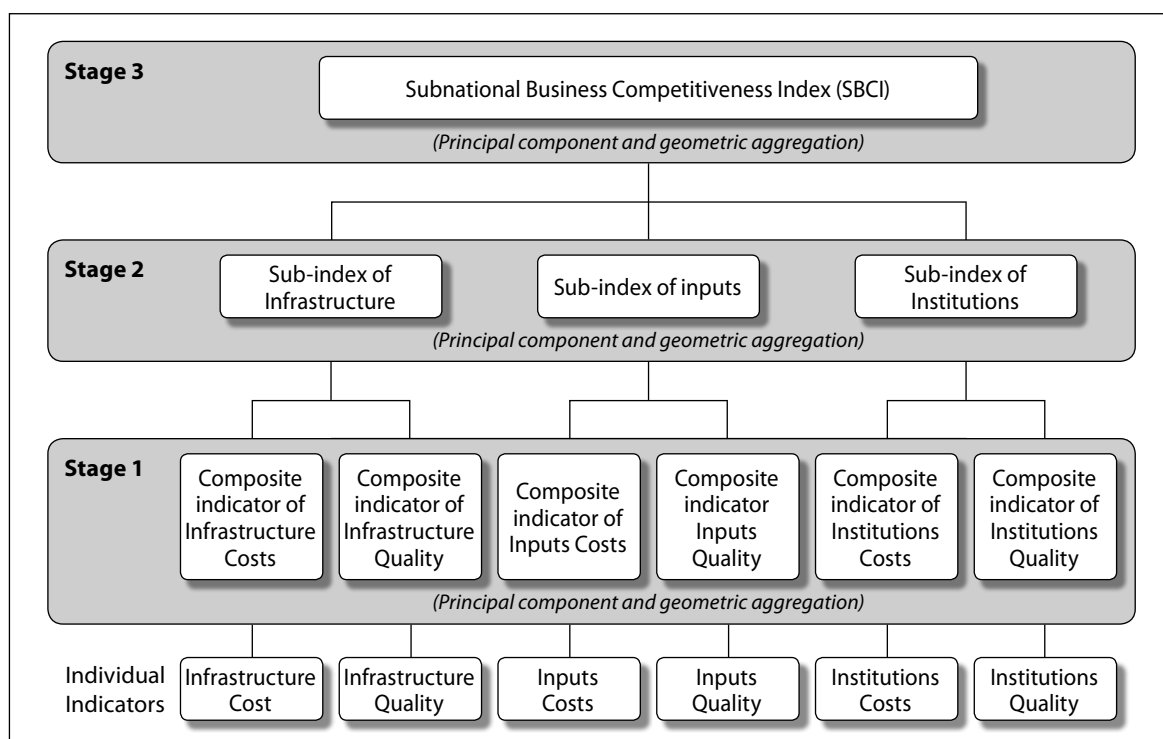
Figure 4. Synoptic view of the SBCI framework.

Index Robustness

Irrespective of what framework is used, a well-designed composite indicator should be linked to the outcome of the phenomenon that it is trying to measure. So, for instance, a well-designed index of business competitiveness should be correlated with outcomes such as manufacturing value added, under the assumption that a more competitive location would be more productive and generate more value added.

Of the three most common indices mentioned earlier, only Porter's index – which uses an approach similar to the one presented in this paper – shows a significant correlation with GDP per capita adjusted for purchasing power, as a measure of robustness of the composite indicator. In the case of the SBCI, the lack of state-level reliable data for indicators appropriate to this test, such as domestic private investment, GDP growth, and export growth, constrained showing such correlations. Nevertheless, earlier work on similar composite indicators showed a clear association with these indicators. For example, in a similar study in 24 East European countries, an index built with a similar methodology showed a clear association between the index and GDP growth as well as firm-level productivity. Similarly, in a paper on 16 Indian states, a similar index showed a significant association with state-level private domestic investment and with state-level GDP growth (Iarossi, 2009; Iarossi, Saliola, & Tanzillo, 2007).

Because of the lack of reliable subnational data, the Enterprise Survey dataset was used to estimate the average level of value added per worker in each state. Value added per worker is often used as proxy for productivity; hence, it is appropriate for this test. The data show a clear and significant association between state-level competitiveness, as reported by the SBCI, and the average productivity firms[15] (see Figure 5).

Although the above test provides some confidence in the design of the composite indicator, the correlation could still be spurious because of endogeneity between the variables used to construct the index and the indicator of productivity used. In other words, it is possible that firms that are more productive will also perform better in the variables used to build the indicator. To account for this possibility, the SBCI was correlated to an indicator of regulatory environment, the state-level Doing Business Indicator. Although this is not the ideal variable to use for this test, the quality of administrative procedures is seen as an important input to business productivity (Branstetter, Lima, Lowell, & Venancio, 2010; Conway, Janod, & Nicoletti, 2005; Nicoletti & Scarpetta, 2003; World Bank, 2009). The test showed an association between the quality of the regulatory environment and the level of competitiveness in the 37 states (see Figure 6). These results provide some confidence in the value of the SBCI composite indicator.
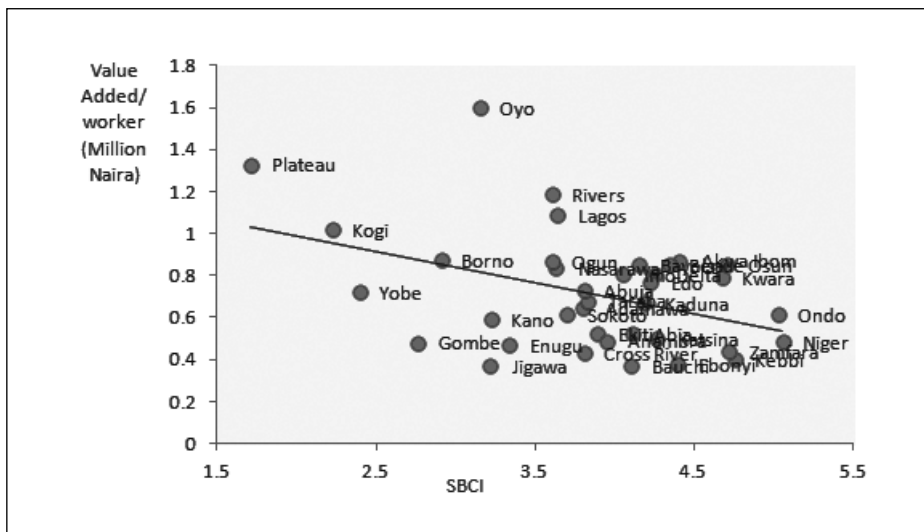

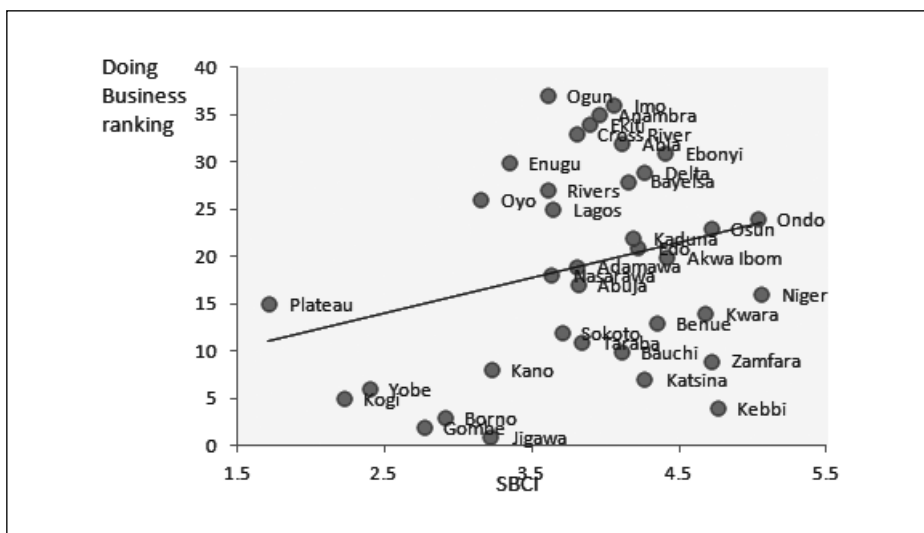*Figure 5.* Value added per worker and SBCI in 37 Nigerian states.

Figure 6. Doing Business ranking and SBCI in 37 Nigerian states.

This method, nevertheless, has two limitations. First, it requires that subnational data be available. Furthermore, when such data are available, it is important that: (a) a sufficient number of aspects of the business environment are measured, and (b) that the same indicators are measured in a comparable manner when different data sources are used. The second limitation is that, by design, the framework is sensitive to the number of localities included in the comparison. In other words, the results obtained by comparing 37 states will most likely be different if a lower number of states are compared. Consequently, the index provides a relative comparison across only those localities included in the estimation.

The Subnational Business Competitiveness Index in 37 Nigerian States

The SBCI was used to assess the level of competitiveness of the 37 Nigerian states. The index produced a ranking shown in Figure 7. When considering this ranking, it is important to remember that the SBCI, as any index, is useful at highlighting broad patterns but should not be taken as indicator of the exact ordinal position of any individual state.[16] Consequently, values that are very close to each other cannot be considered as representing the exact position of a state. For instance, the difference between Etiki, Anambra, and Imo is so small that it would not be correct to assume that the exact ranking among these three states is strictly the one reported on the chart. Rather, it is more appropriate to conclude that these three states share the same level of competitiveness.

According to the SNBCI ranking shown in Figure 7, the 37 Nigerian states can be classified in five groups. The first state with the most competitive stance is Plateau, followed by Kogi and Yobe. The second group includes Gombe, Borno, Oyo, Jigawa, Kano, and Enugu. These are followed by Rivers, Ogun, Nasarawa, Lagos, Sokoto, Adamawa, Cross River, Abuja, and Taraba. The fourth group includes Ekiti, Anambra, Imo, Bauchi, Abia, Bayelsa, Kaduna, Edo, Delta, Katsina, Benue, Ebonyi, and Akwa Ibom, which show a lower level of competitiveness. Finally, the lowest competitiveness is found in Kwara, Osun, Zamfara, Kebbi, Ondo, and Niger.
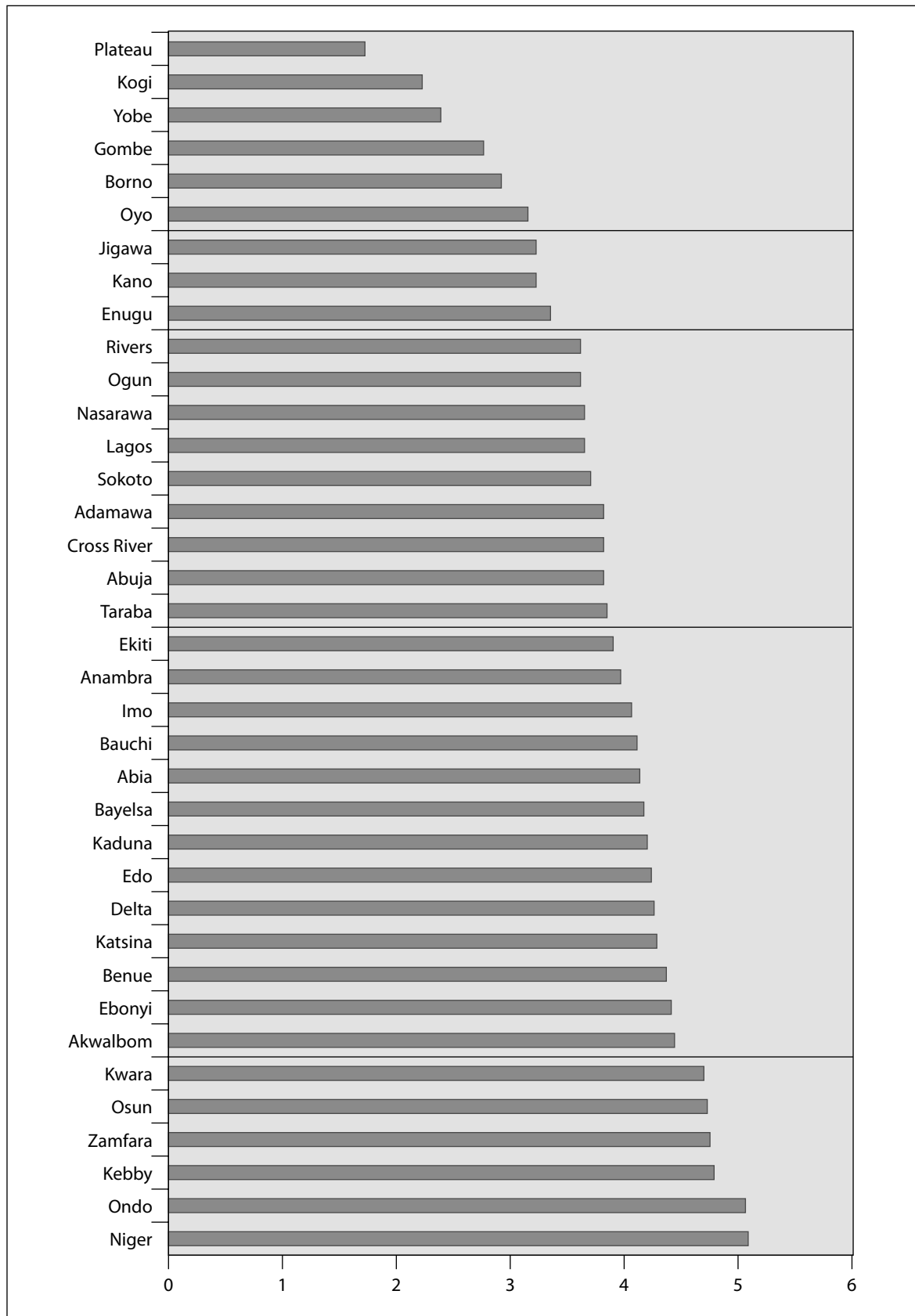
Figure 7. Subnational business competitiveness index in 37 Nigerian states.

While individual state ranking is interesting in itself, the real value of this exercise is not to name which is more or less competitive, but rather to identify what policy reforms would help each state improve its competitiveness. A comparison of all the indicators used to characterize the level of competitiveness reveals which characteristics of the local business environment are more problematic than others. For instance, a comparison of perceptions shows that electricity is the constraint for which most of the firms complain across states (see Figure 8). The issue, though, is whether electricity should be the top reform in every state, and whether Jigawa (with the fifth lowest level of electricity complaints) should reform electricity rather than courts (where it performs the worst of all states). In other words, just looking at the constraints will not provide an order of priority of areas for reform.

In contrast, the methodology used to build the composite indicator makes it possible to isolate which groups of variables are more important than others. Hence, decomposing the SBCI leads to determining the main drivers of competitiveness in each Nigerian state.
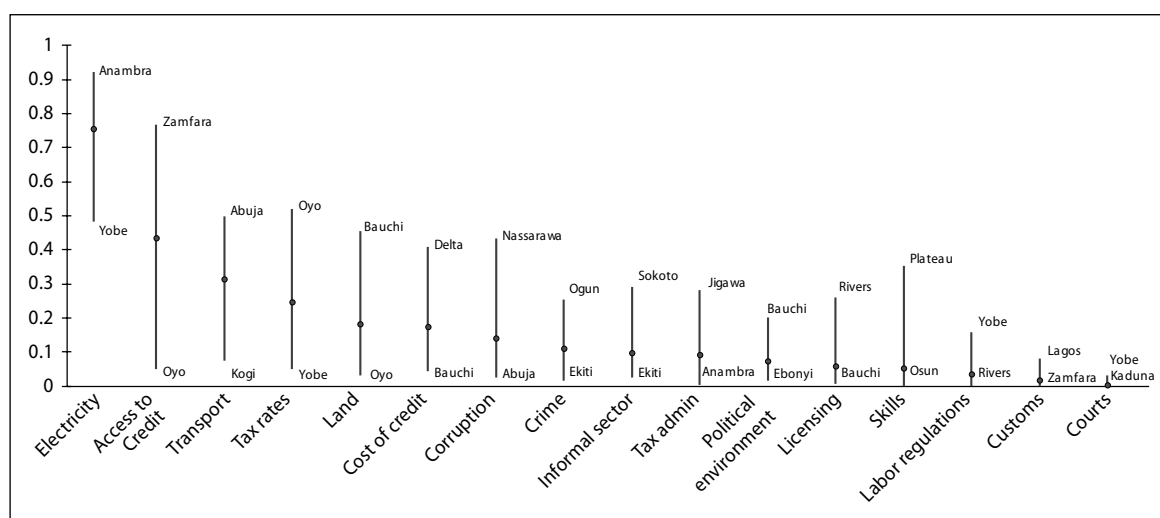

Figure 8. Ranking of perceptions.

Impact of Reforms

Improving the competitiveness stand across Nigerian states remains one of the main challenges of Nigeria's reform program. The main problem, as stated above, is not to name reforms, but rather to identify which reforms should take priority.

This challenge was tackled by estimating the impact of different reforms on the SBCI. The goal was to identify the top three reforms with the highest impact on state-level competitiveness, as reported by the index. The term *reform* here is used to indicate an improvement in a state-level indicator such that its new value is equivalent to the corresponding value of that indicator in the highest performing state. So, for example, the reform of Eriki's licensing regime[17] is accomplished by replacing the value of the licensing indicator for Eriki with the corresponding value for Bauchi, the state with the best performance in terms of licensing. Taking as reference the reform in another Nigerian state implies that such level of performance is feasible within the Nigerian context since another state has achieved it.

A two-step procedure was followed. In the first step, each of the 41 indicators in each of the 37 states was reformed (as defined above), and the SBCI was reestimated in each case, while keeping the same structural coefficients as in the original estimation of the index.[18] In other words, the task was to estimate what would have been the ranking of the state with this reform, had nothing else changed, including the structural coefficients of the principal component model.[19]

In the second step, the three reforms with the highest impact on the SBCI in each state was identified and the model was re-estimated with these three reforms simultaneously (again keeping the same coefficients of the original structural model). The impact of these reforms is shown in Figure 9. The dark bar represents by

how much the competitiveness index would improve following such reforms, and the light bar represents the final value of the SBCI after the reforms have been implemented.
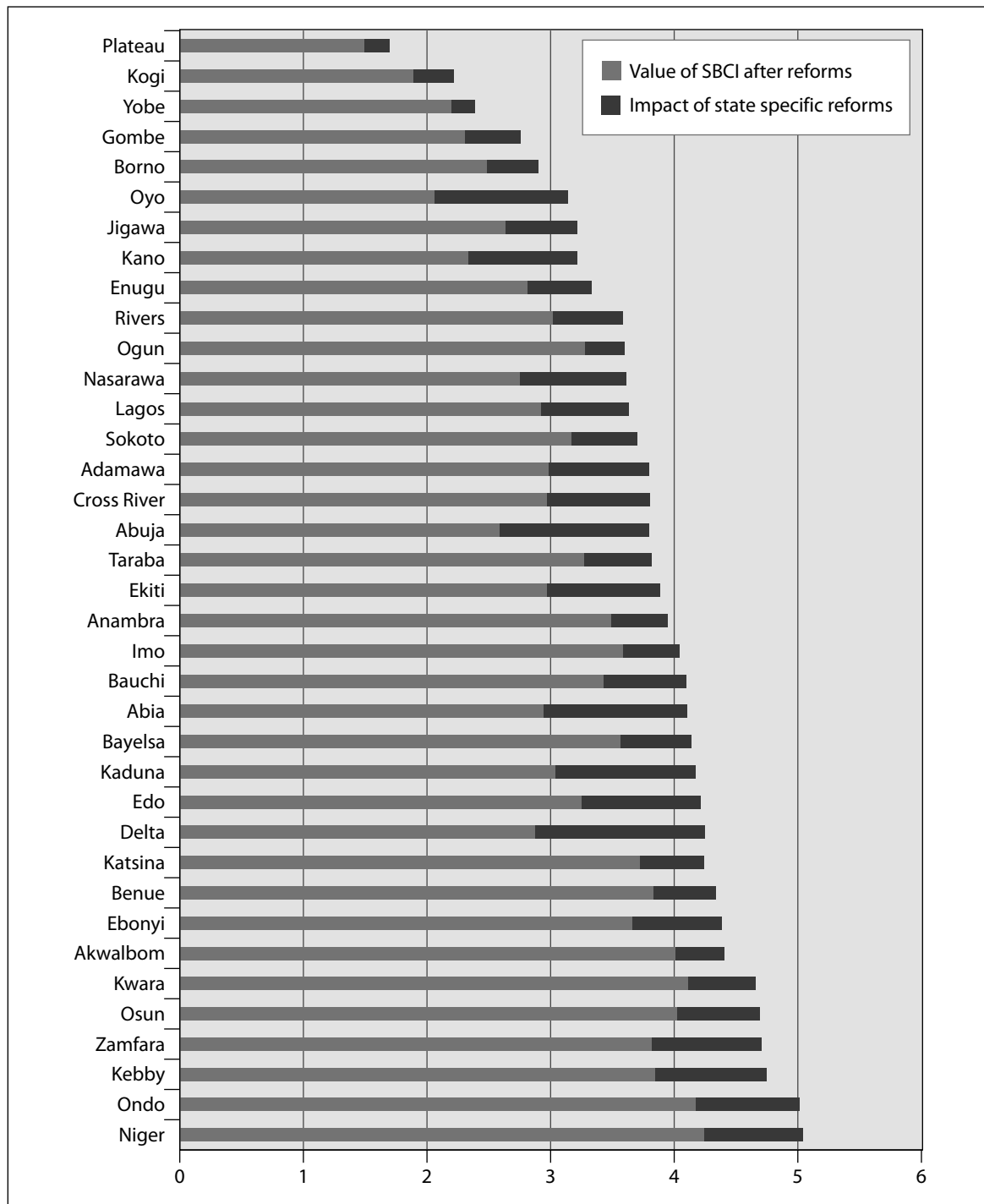

Figure 9. Impact on the SBCI of reforming the top three constraints.

Three interesting observations result from these simulations. First, as expected, the lower the original level of competitiveness, the higher the impact of reforms. States in the bottom part of the chart experience a higher level of improvement in competitiveness as they implement these three reforms. Second, and unsurprisingly, the impact of reforms is not homogeneous across states. Some states experience a much higher impact on the index than others experience. Although all states improve their standing, some states lose positions in the new

ranking because of the heterogeneous impact of reforms. The implication of this result is that in some states, especially those towards the bottom of the chart, the business environment needs more than three reforms in order to show a significant impact on competitiveness. Finally, in some states, the three reforms identified really represent the binding constraints to competitiveness, given the high impact they have on the index. For instance, in Delta, Abia, and Abuja, the impact of the reforms is so significant as to bring those 9 to 15 positions up in the ranking.

Table 3 lists the reforms for each state. Out of the 41 proxies used, only 10 remain the most important constraints to improve competitiveness. Furthermore, three of them – infrastructure (transport and electricity), access to finance, and health – represent almost all the reforms identified by the simulation (85%) (see Figure 10). Since transport, and to some extent electricity, are policy reforms that go beyond state borders, this method has also identified reforms that need to be taken at the federal level.

Table 3
The Three Most Important State Reforms to Improve Competitiveness

| Abia	Abuja	Adamawa	Akwa Ibom
1 Transport	1 Transport	1 Transport	1 Interest rates
2 Electricity	2 Electricity	2 Health	2 Access to finance
3 Health	3 Access to finance	3 Access to finance	3 Transport
Anambra	**Bauchi**	**Bayelsa**	**Benue**
1 Electricity	1 Health	1 Electricity	1 Transport
2 Health	2 Access to finance	2 Interest rates	2 Transport
3 Transport	3 Political instability	3 Access to finance	3 Health
Borno	**Cross River**	**Delta**	**Ebonyi**
1 Political instability	1 Health	1 Interest rates	1 Electricity
2 Transport	2 Electricity	2 Electricity	2 Transport
3 Health	3 Transport	3 Access to finance	3 Access to land
Edo	**Ekiti**	**Enugu**	**Gombe**
1 Transport	1 Transport	1 Transport	1 Health
2 Health	2 Interest rates	2 Electricity	2 Political instability
3 Transport	3 Access to finance	3 Interest rates	3 Access to finance
Imo	**Jigawa**	**Kaduna**	**Kano**
1 Transport	1 Transport	1 Electricity	1 Access to finance
2 Health	2 Health	2 Transport	2 Interest rates
3 Electricity	3 Electricity	3 Access to land	3 Electricity
Katsina	**Kebbi**	**Kogi**	**Kwara**
1 Electricity	1 Electricity	1 Electricity	1 Electricity
2 Transport	2 Transport	2 Access to finance	2 Transport
3 Transport	3 Access to finance	3 Interest rates	3 Taxes
Lagos	**Nasarawa**	**Niger**	**Ogun**
1 Transport	1 Transport	1 Transport	1 Electricity
2 Transport	2 Electricity	2 Transport	2 Transport
3 Electricity	3 Corruption	3 Access to finance	3 Transport
Ondo	**Osun**	**Oyo**	**Plateau**
1 Electricity	1 Electricity	1 Transport	1 Electricity
2 Transport	2 Transport	2 Health	2 Short term finance
3 Transport	3 Transport	3 Electricity	3 Skills
Rivers	**Sokoto**	**Taraba**	**Yobe**
1 Health	1 Electricity	1 Transport	1 Transport
2 Electricity	2 Transport	2 Transport	2 Transport
3 Access to finance	3 Health	3 Access to financer	3 Political instability
Zamfara			
1 Electricity			
2 Transport			
3 Access to finance			
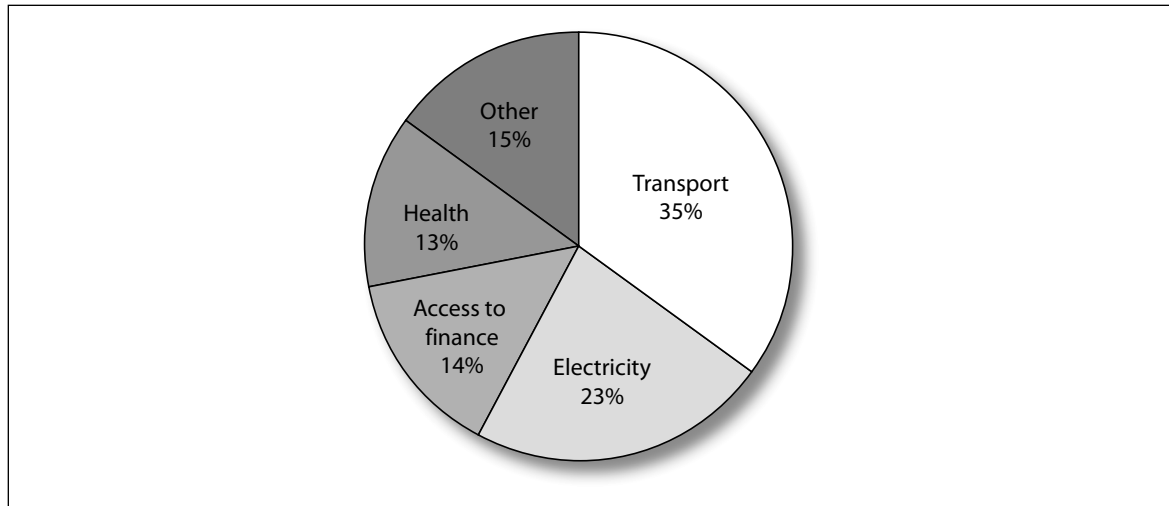
Figure 10. Distribution of all state reforms.

Conclusions

In this paper, a new method to estimate competitiveness at the subnational level has been presented and applied to identify policy priorities in support of competitiveness in a locality. Based on the definition of competitiveness as productivity, this study develops a competitiveness index that estimates the latent features of competitiveness, is able to combine indicators measured differently, and does not allow for constant compensability across indicators. The index was estimated for 37 Nigerian states that were ranked according to their competitiveness standing. Most importantly, the index was used to simulate the impact of policy reforms and to identify the reforms with the highest impact on competitiveness. The ultimate objective of this tool is to inform policy discussion on state as well as federal policy reforms and hence contribute to the development agenda of the private sector in countries around the world.

Endnotes

[1] A simple Google search of definition of competitiveness generated over 8 million hits.

[2] See Annex 1 for a short description of these indices.

[3] As a matter of fact, the OECD definition associates competitiveness with the ability of a country to export "under free and fair conditions while maintaining and expanding real incomes of its population over the long term" (OECD, 1992, p. 242).

[4] The goal is to avoid that easy-to-implement reforms in areas where performance is already good have the same impact on the index as hard-to-implement reforms in areas where performance is weak.

[5] Other factors are also important, but they are not included either because they are invariant across localities (such as openness, trade policy, macro stability) or because of lack of data at the subnational level (such as managerial ability) (Salomon, 2009).

[6] These data include firm-level surveys in over 100 countries periodically updated. See www.enterprisesurveys.org for more details.

[7] We did not use imputation, and we used a minimum number of respondents (five) in order for each individual variable to be included in the set. Outliers were also omitted. The average value of the state-level sample is used.

[8] This is consistent with some part of the literature showing that perceptions are correlated with objective measures of the business environment (see Clarke, 2013; Gelb et al., 2006; Hallward-Driemeier & Aterido, 2009; Hellman, Jones, Kaufmann, & Schankerman, 1999; Iarossi, 2006; Pierre & Scarpetta, 2006).

[9] See Table A1 in Annex 2 with the correlation matrix of these variables.

[10] Principal Component Analysis (PCA) is a mathematical procedure that transforms a number of correlated observations into a smaller number of uncorrelated variables while retaining as much as possible of the variance of the original data set. This is achieved by transforming the original data into a new set of linear combinations called principal components or factors. The principal components are orthogonal and are ordered in such a way that the first accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability

as possible. Hence, the first few components retain most of the variance of all original variables. The number of principal components is less than or equal to the number of original variables; hence, PCA is a method for data reduction (Joliffe, 2002).

[11] In other words, we cannot tell if the provision of reliable electricity should count twice as much as the availability of a good transport system in the determination of competitiveness of a locality.

[12] In our case, if we were to estimate the composite index using all the variables, irrespective of their number within each category, we would inadvertently give more weight to institutions simply because the number of variables available within that category is higher.

[13] In the aggregation process, factors are rescaled to positive numbers greater than 1 so that the exponential weight has the intended effect, and the sum of the weights is normalized to 100. Finally, we retain as many factors as to explain at least 70% of the total variance.

[14] That is, for each retained factor, we use as weight the corresponding share of variance it explains.

[15] Note that a lower value of the SBCI index corresponds to a higher level of competitiveness.

[16] Since the SBCI is a linear combination of factors estimated from a sample of the population, the value of each index has a margin of error.

[17] Indicator No. 4 of Institutions Quality.

[18] We retain the same coefficients of the factors estimated in Stage 1 of the aggregation process.

[19] This process produces 1517 SBCI indices, one for each individual reform in each state.

[20] http://www.imd.org/research/publications/wcy/index.cfm accessed on April 14, 2013.

[21] A more recent version appears in Delgado, Ketels, Porter, and Stern (2012).

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Appendix A

Competitiveness Indices in the Literature

The most common competitiveness indices found in the literature are the World Economic Forum's *Global Competitiveness Index* (GCI), the International Institute for Management Development's *World Competitiveness Index*, and Porter's *Competitiveness Index*.

The GCI defines competitiveness as the set of institutions, policies, and factors that determine the level of productivity of an economy (World Economic Forum, 2013). First launched in 1979, covering 16 countries only, today it includes rankings for over 130 countries. The CGI uses a wide set of quantitative measures comparable across countries from publicly available datasets and from a proprietary survey of business executives. All these indicators are grouped in 12 pillars: institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labor market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation. The model assumes that the process of economic development evolves in three subsequent stages: factor-driven (economies compete in prices, taking advantage of cheap factors), efficiency-driven (economies adopt efficient production practices to increase productivity), and innovation-driven (economies produce innovative products using sophisticated production methods). Each country is assigned one stage of development based on GDP per capita and the share of mineral exports out of total exports. The variables are combined in a weighted index, where the weights are estimated in a regression model linking stage of development and income level.

The International Institute for Management Development adopts a definition of competitiveness that goes beyond productivity and includes political, cultural, and social dimensions of the environment in which enterprises operate. Since 1989, it has been measuring competitiveness through an index published in the annual *World Competitiveness Yearbook*. The index measures national competitiveness and combines quantitative and survey data of more than 300 variables divided in five groups (factors) and 20 subgroups (subfactors). The five factors are economic performance, government efficiency, business efficiency, infrastructure, and people. The subfactors include domestic economy, international trade, international investment, employment, prices, public finance, fiscal policy, institutional framework, business legislation, societal framework, productivity, labor market, finance, management practices, attitudes and values, basic infrastructure, technological infrastructure, scientific infrastructure, health and environment, and education. Each subgroup is assigned an equal weight in the construction of the overall index. The index covers 59 countries.[20]

A more recent index, called here Porter's *Competitiveness Index*, adopts a methodology closer to the one proposed in this paper and was first presented in the World Economic Forum's *Global Competitiveness Report* 2008-2009 (Porter et al., 2008)[21]. This method classifies countries in stages of development based on the level of manufacturing exports per capita and patents per capita. It also captures countries' endowments that have a direct impact on prosperity but not on productivity by controlling for natural resources, land area, and market size. The data used come from publicly available sources and firm-level surveys. The variables are grouped into two broad categories: micro and macro. Each category then includes two subcategories, company operations and strategy, national business environment, social infrastructure and political institutions, and macroeconomic policies. Each subgroup includes a set of subsubgroups (17 in total). Finally, the groups are aggregated into a composite of indicators using the principal component technique applied in multiple stages of aggregation.

Appendix B

Table B1
Correlation Matrix of Variables Used in the SBCI

	Size of inventory (transport quality)	Power outages: hours per shift	Power outages: losses (% sales)	Own generator (share of firms)	Electricity from own generator (%)	Own transportation (share of firms)	Use of own transportation (% of sales)	Sales sold on credit (%)
Size of inventory (transport quality)	1.00							
Power outages: hours per shift	0.33	1.00						
Power outages: losses (% sales)	-0.25	0.11	1.00					
Own generator (share of firms)	0.28	0.34	-0.08	1.00				
Electricity from own generator (%)	0.35	0.63	-0.24	0.36	1.00			
Own transportation (share of firms)	0.43	0.18	0.01	0.51	0.10	1.00		
Use of own transportation (% of sales)	0.48	-0.08	-0.41	0.07	0.18	0.31	1.00	
Sales sold on credit (%)	-0.35	0.33	0.47	0.15	0.09	-0.14	-0.43	1.00
Sales as intermediate products (%)	-0.19	0.01	-0.06	-0.05	0.13	-0.22	0.10	0.08
Inputs paid before delivery (%)	-0.11	0.30	0.31	-0.04	0.18	0.07	-0.29	0.56
ISO certification (share of firms)	-0.41	-0.23	-0.04	-0.34	-0.08	-0.56	-0.29	-0.17
Workforce absenteeism: HIV/AIDS	-0.19	0.06	0.20	-0.07	-0.02	-0.30	-0.33	0.24
Share of long term financing (equity)	0.23	-0.06	-0.17	0.24	0.14	0.02	0.28	0.01
Share of firms with loan	-0.41	-0.03	0.65	-0.24	-0.39	-0.12	-0.30	0.38
Share of firms that need a loan but do not apply	-0.38	-0.17	0.00	-0.35	-0.23	-0.26	-0.31	0.15
Workforce absenteeism: Malaria	0.23	0.09	-0.11	0.00	0.03	0.15	0.37	-0.33
Degree of competition	0.07	-0.02	0.06	-0.09	-0.27	0.17	0.22	-0.14
Losses due to theft (% sales)	0.23	0.20	0.32	0.14	-0.05	0.36	0.08	0.14
Bribes for government contract (% value)	0.30	0.29	-0.18	0.26	0.29	0.16	-0.08	0.14
Electric connection days	0.05	0.08	0.10	0.14	0.03	0.11	-0.37	-0.03
Visits by tax officials	0.09	0.11	0.17	0.10	0.08	0.14	-0.27	0.08
Tax evasion (% sales)	0.19	0.35	-0.14	0.35	0.29	0.02	-0.06	-0.12

Table B2
Correlation Matrix of Variables Used in the SBCI

	Size of inventory (transport quality)	Power outages: hours per shift	Power outages: losses (% sales)	Own generator (share of firms)	Electricity from own generator (%)	Own transportation (share of firms)	Use of own transportation (% of sales)	Sales sold on credit (%)
Customers' purchase orders in writing	-0.14	0.26	0.27	0.12	0.09	0.29	-0.25	0.39
Costs of state regulations	0.02	0.31	0.34	-0.13	0.20	-0.11	-0.23	0.33
Cost of federal regulations	0.12	0.26	0.39	0.00	0.12	0.07	-0.19	0.22
Electricity constraint	-0.22	-0.09	0.04	-0.06	-0.16	0.01	0.12	0.32
Transport constraint	-0.09	-0.05	-0.01	-0.32	-0.06	-0.02	0.22	0.08
Access to land constraint	-0.38	0.07	0.27	-0.26	-0.01	-0.52	-0.30	0.47
Access to finance constraint	0.01	-0.25	-0.18	-0.39	-0.17	-0.44	0.22	-0.27
Cost of finance constraint: Short term	-0.05	0.11	0.02	0.01	0.09	-0.19	0.18	-0.12
Inadequately educated workforce constraint	0.03	-0.10	0.00	-0.06	-0.01	0.00	-0.26	0.04
Customs constraint	-0.15	-0.01	0.33	0.03	-0.28	0.00	-0.16	0.22
Crime constraint	-0.15	-0.20	0.09	-0.14	-0.32	0.14	-0.01	-0.11
Corruption constraint	0.13	0.24	0.00	0.31	0.27	0.10	-0.32	0.15
Licensing & permits constraint	-0.20	0.00	0.35	0.01	-0.13	-0.02	-0.48	0.14
Tax rates constraint	0.11	0.16	-0.08	0.11	0.15	0.26	0.17	0.11
Tax administration constraint	0.15	0.23	0.26	0.31	0.15	0.32	-0.24	0.06
Functioning of courts constraints	0.43	0.23	0.02	0.47	0.25	0.19	0.12	-0.06
Political environment constraint	-0.04	0.15	0.13	0.34	0.06	0.21	-0.26	0.22
Labor regulations constraint	0.11	0.09	0.19	0.28	0.14	0.12	-0.24	0.04
Practise of informal sector constraint	-0.16	-0.04	0.09	-0.08	-0.10	-0.15	0.34	-0.06

Table B3
Correlation Matrix of Variables Used in the SBCI

	Sales as intermediate products (%)	Inputs paid before delivery (%)	ISO certification (share of firms)	Workforce absenteeism: HIV/AIDS	Share of long term financing (equity)	Share of firms with loan	Share of firms that need a loan but do not apply	Workforce absenteeism: Malaria
Sales as intermediate products (%)	1.00							
Inputs paid before delivery (%)	-0.04	1.00						
ISO certification (share of firms)	0.15	-0.54	1.00					
Workforce absenteeism: HIV/AIDS	0.06	0.21	-0.09	1.00				
Share of long term financing (equity)	-0.04	-0.04	-0.13	-0.08	1.00			
Share of firms with loan	-0.02	0.26	-0.09	0.12	-0.34	1.00		
Share of firms that need a loan but do not apply	0.03	-0.17	0.30	0.09	-0.03	0.26	1.00	
Workforce absenteeism: Malaria	0.04	-0.27	-0.03	0.02	0.02	-0.11	-0.32	1.00
Degree of competition	-0.25	-0.37	0.13	-0.25	-0.07	0.19	0.20	0.24
Losses due to theft (% sales)	-0.05	0.23	-0.51	0.22	-0.04	0.04	-0.21	0.26
Bribes for government contract (% value)	0.35	0.07	-0.13	0.10	0.10	-0.38	0.05	-0.08
Electric connection days	0.03	0.00	0.15	-0.06	0.14	-0.24	0.00	0.04
Visits by tax officials	-0.04	0.03	0.09	-0.02	0.16	0.05	0.02	-0.02
Tax evasion (% sales)	0.09	-0.32	0.16	0.03	-0.16	-0.18	-0.17	0.22
Customer's purchase orders in writing	-0.27	0.55	-0.42	0.09	-0.23	0.38	0.17	-0.39
Cost of state regulations	0.15	0.51	-0.14	0.54	-0.12	0.09	-0.23	0.03

Table B4
Correlation Matrix of Variables Used in the SBCI

	Sales as intermediate products (%)	Inputs paid before delivery (%)	ISO certification (share of firms)	Workforce absenteeism: HIV/AIDS	Share of long term financing (equity)	Share of firms with loan	Share of firms that need a loan but do not apply	Workforce absenteeism: Malaria
Cost of federal regulations	0.04	0.48	-0.20	0.11	-0.06	0.32	-0.27	-0.01
Electricity constraint	-0.25	0.35	-0.37	0.19	-0.08	0.34	0.15	-0.19
Transport constraint	-0.19	0.25	-0.12	-0.09	-0.09	0.26	-0.14	-0.02
Access to land constraint	0.12	0.15	0.34	0.18	0.06	0.44	0.19	0.04
Access to finance constraint	-0.07	-0.50	0.36	-0.24	0.10	0.11	0.33	0.35
Cost of finance constraint: Short term	-0.36	-0.04	0.00	0.01	-0.09	0.11	-0.04	0.02
Inadequately educated workforce constraint	0.27	0.11	0.00	0.08	0.02	-0.12	0.12	-0.16
Customs constraint	-0.09	0.19	-0.19	0.09	-0.11	0.35	-0.15	-0.15
Crime constraint	-0.04	0.03	-0.14	0.26	-0.49	0.36	-0.18	0.35
Corruption constraint	0.07	0.25	-0.03	0.20	-0.06	-0.27	-0.15	-0.33
Licensing & permits constraint	0.18	0.00	-0.02	0.36	-0.20	0.11	0.08	0.05
Tax rates constraint	0.05	0.08	-0.17	-0.08	0.02	-0.24	-0.03	-0.04
Tax administration constraint	0.12	0.15	-0.11	-0.05	-0.04	-0.11	-0.20	-0.11
Functioning of courts constraint	0.17	-0.05	-0.20	0.02	0.12	-0.22	-0.37	-0.12
Political environment constraint	-0.15	-0.01	0.10	-0.13	0.16	0.10	0.07	0.01
Labor regulations constraint	0.29	0.02	0.10	0.08	0.06	-0.16	-0.22	-0.27
Practise of informal sector constraint	0.30	0.00	-0.13	0.09	0.00	0.31	-0.11	0.27

Table B5
Correlation Matrix of Variables Used in the SBCI

	Degree of competition	Losses due to theft (% sales)	Bribes for government contract (% value)	Electric connection days	Visits by tax officials	Tax evasion (% sales)	Customer's purchase orders in writing	Costs of state regulations
Degree of competition	1.00							
Losses due to theft (% sales)	-0.11	1.00						
Bribes for government contract (% value)	-0.38	0.05	1.00					
Electric connection days	0.05	-0.24	0.26	1.00				
Visits by tax officials	0.07	-0.13	0.16	0.43	1.00			
Tax evasion (% sales)	0.16	0.02	0.19	0.09	0.10	1.00		
Customers' purchase orders in writing	-0.11	0.11	-0.13	-0.10	0.13	-0.23	1.00	
Costs of state regulations	-0.37	0.38	0.10	-0.03	0.11	-0.12	0.25	1.00
Cost of federal regulations	-0.10	0.00	-0.03	0.15	0.37	-0.11	0.32	0.66
Electricity constraint	-0.02	0.24	-0.27	-0.68	-0.39	-0.19	0.38	0.04
Transport constraint	-0.05	0.13	-0.24	-0.65	-0.19	-0.14	0.09	0.09
Access to land constraint	0.03	-0.16	-0.21	-0.22	0.00	0.08	-0.10	0.15
Access to finance constraint	0.34	-0.25	-0.32	-0.19	-0.19	0.03	-0.40	-0.47
Cost of finance constraint: Short term	0.18	0.00	-0.47	-0.25	-0.20	0.01	0.21	-0.08
Inadequately educated workforce constraint	-0.19	-0.29	0.39	0.65	0.34	-0.03	0.04	0.14
Customs constraint	-0.09	0.15	-0.34	0.29	0.04	-0.03	0.30	0.18
Crime constraint	-0.01	0.15	-0.27	-0.23	0.00	-0.05	0.23	0.10
Corruption constraint	-0.40	-0.09	0.52	0.49	0.42	0.03	0.24	0.41
Licensing & permits constraint	-0.17	0.22	0.07	0.35	0.24	0.07	0.07	0.12
Tax rates constraint	-0.14	0.33	0.21	-0.37	-0.37	-0.18	-0.08	0.06
Tax administration constraint	0.03	-0.03	0.24	0.74	0.40	0.10	0.11	0.17
Functioning of courts constraints	-0.18	0.16	0.47	0.16	0.18	0.19	-0.07	0.15
Political environment constraint	0.26	-0.01	-0.13	0.29	0.29	0.25	0.05	-0.17
Labor regulations constraint	-0.23	-0.14	0.44	0.57	0.42	0.06	-0.03	0.26
Practise of informal sector constraint	0.00	0.14	-0.24	-0.27	-0.17	0.11	0.16	0.08

Table B6
Correlation Matrix of Variables Used in the SBCI

	Cost of federal regulations	Electricity constraint	Transport constraint	Access to land constraint	Access to finance constraint	Cost of finance constraint: Short term	Inadequately educated workforce constraint	Customs constraint
Cost of federal regulations	1.00							
Electricity constraint	-0.12	1.00						
Transport constraint	0.05	0.49	1.00					
Access to land constraint	0.14	0.24	0.24	1.00				
Access to finance constraint	-0.34	-0.03	0.05	0.38	1.00			
Cost of finance constraint: Short term	-0.14	0.20	0.18	-0.01	0.31	1.00		
Inadequately educated workforce constraint	0.23	-0.38	-0.57	-0.19	-0.23	-0.50	1.00	
Customs constraint	0.32	0.26	0.31	0.23	-0.06	0.15	-0.13	1.00
Crime constraint	0.08	0.25	0.19	-0.07	-0.06	-0.05	-0.08	0.27
Corruption constraint	0.33	-0.33	-0.47	-0.33	-0.65	-0.24	0.56	-0.23
Licensing & permits constraint	-0.01	-0.38	-0.35	-0.13	-0.13	-0.11	0.25	0.22
Tax rates constraint	-0.11	0.22	0.17	-0.17	-0.23	-0.32	-0.24	-0.04
Tax administration constraint	0.41	-0.61	-0.48	-0.40	-0.49	-0.14	0.45	-0.14
Functioning of courts constraints	0.18	-0.38	-0.23	-0.41	-0.42	-0.13	0.05	-0.30
Political environment constraint	-0.02	-0.15	-0.26	0.20	-0.14	-0.30	0.03	-0.15
Labor regulations constraint	0.34	-0.62	-0.39	-0.25	-0.53	-0.30	0.44	-0.20
Practise of informal sector constraint	0.04	0.28	0.10	0.18	0.19	0.31	-0.13	0.13

Table B7
Correlation Matrix of Variables Used in the SBCI

	Crime constraint	Corruption constraint	Licensing & permits constraint	Tax rates constraint	Tax administration constraint	Functioning of courts constraint	Political environment constraint	Labor regulations constraint	Practise of informal sector constraint
Crime constraint	1.00								
Corruption constraint	-0.10	1.00							
Licensing & permits constraint	0.22	0.06	1.00						
Tax rates constraint	-0.19	-0.13	-0.12	1.00					
Tax administration constraint	-0.25	0.55	0.32	-0.20	1.00				
Functioning of courts constraint	-0.21	0.54	0.02	-0.04	0.51	1.00			
Political environment constraint	-0.15	0.08	0.05	-0.01	0.16	0.06	1.00		
Labor regulations constraint	-0.21	0.71	0.26	-0.26	0.74	0.73	0.11	1.00	
Practise of informal sector constraint	0.34	-0.20	-0.15	-0.43	-0.23	0.00	-0.22	-0.14	1.00