The Highways and Side Roads of Statistical Capacity Building

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Europe and Central Asia Region
Office of the Chief Economist
August 2021

Abstract

This paper proposes an approach to guide statistical capacity building in developing countries using an analysis based on components of the World Bank's Statistical Performance Indicator on a sample of 215 countries. The approach demonstrates the importance of expanding traditional capacity-building activities to include programs to strengthen and better monitor user demand for data. Based on this analysis, the paper recommends a two-step strategy for building and enhancing the sustainable statistical capacity of national statistical systems in developing countries. The strategy creates a sustainable trajectory for developing national statistical systems that meet the growing demands of local and global data users. The paper emphasizes the importance of donor coordination and South-South learning initiatives for international capacity-building efforts.

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Declaration of Interest: None

1. Introduction

The national statistical system (NSS) is the ensemble of statistical organizations and units in a country that jointly collect, process, and disseminate official statistics on behalf of the government (OECD 2002). It plays a vital role in modern economies, providing a range of stakeholders with statistical information on the country's socioeconomic evolution at the national and subnational levels.

NSS performance is constrained by its statistical capacity, defined as "the ability of a country's national statistical system, its organizations, and individuals, to collect, produce, analyze, and disseminate high quality and reliable statistics and data to meet users' needs" (Paris21 2017a). Weak statistical capacity restricts development. Planning and monitoring progress are hampered when statistics are inaccurate, irrelevant, slow to be disseminated, or missing entirely (Devarajan 2013). Lack of data limits stakeholders' ability to hold governments accountable for their actions and prevents civil society from drawing attention to gaps in government services (UNSC 2017).

Weak statistical capacity restricts innovation. Some high-capacity NSSs have developed new methods, tapped new data sources, and quickly formed strategic partnerships to produce the information necessary to understand how best to respond to the COVID-19 crisis (UNECE 2020a). But many others have struggled to adapt their data-collection processes in the face of quarantines and other social distancing measures (UNDESA 2020).

Statistical systems in many developing countries rely on international support to build capacity. These efforts focus on improving the supply of data, often neglecting strengthening data demands by the country's state and nonstate actors. State demand for data reflects the technical capacity of the bureaucracy to use data to develop programs and policies and deliver public services. This technical capacity is higher in countries where the bureaucracy can work without political interference (Fukuyama 2013) and with autonomy from pressures that might jeopardize objective policy implementation (Bersch, Praça, and Taylor 2017). Nonstate actors—think tanks, academia, civil society, private sector actors, and the public—use data to hold governments accountable, advocate for policy priorities, make business decisions, and track socioeconomic conditions.

The share of official development assistance for data and statistics has stagnated over the last decade while data demands soared (PARIS21 2017a). In this environment, better-targeted, smarter

interventions that address both the supply of and the demand for data are needed to fully capture the potential of the data revolution to create a world of greater prosperity and sustainable development (Badiee et al. 2017). Therefore, it is critical for development institutions to allocate resources to countries that would benefit from such interventions the most.

The prioritization of interventions requires a transparent and objective metric to compare countries' statistical capacity. The Statistical Performance Indicator (SPI), originally developed by Cameron et al. (2021), facilitates such comparisons, both over time and across countries.

This paper discusses the use of the SPI to guide development policies to improve and sustain statistical capacity in developing countries. With greater international attention on emphasizing the user responsiveness of national statistical systems, there is pressure to align statistical products and services to the needs of each country. The SPI can be used to evaluate the capacity of statistical systems to supply data and assess how well this supply aligns with local and international demands for data and services.

Analysis of the distribution of the SPI and its components over a sample of 215 countries reveals two distinct clusters of NSSs—low and high performing—separated by a relatively wide gap in SPI scores. Furthermore, poorly performing NSSs also have high variance across SPI components. Such variance hampers the ability of poorly performing NSSs to deliver their services.

Our benchmarking regression analysis identifies three types of NSSs: a group of NSSs that under-supply data to their users; a group that seems to be producing too much data, given the country's characteristics; and a group that appears to be at the equilibrium point in terms of demand for and supply of data. These three groups motivate our proposed two-step strategy for building and enhancing sustainable statistical capacity in developing countries.

Our main proposal is to align the NSS's capacity-building activities with the data priorities expressed by local actors and their capability to act on these data. Only when the supply of data corresponds to the demand for them can NSSs be sustainable in the long term. Our findings emphasize the importance of coordination by the donor community and South–South learning and experience exchange initiatives. Such coordination could be especially important in helping countries that reach middle-capacity status but are challenged to graduate to the pool of top NSSs.

One of the challenges of donor-led statistical capacity building is to develop statistical systems that can function independently. External international aid should not lead to perpetual dependency. The strategy proposed in this paper creates a sustainable trajectory for developing NSSs that meets the growing demands of local and global data users.

The paper is organized as followings. Section 2 discusses the evolution of approaches to statistical capacity building and reviews measures of statistical capacity. Section 3 discusses the main properties of the SPI and provides some descriptive results. Section 4 presents the methodology for assessing demand for and supply of data. Section 5 discusses the policy implications of our analysis. Section 6 summarizes the paper's main conclusions.

2. Evolution and Measurement of Statistical Capacity

Over the past 20 years, new data sources and increasing user demands have redefined what is meant by a capable NSS. As a result, assessment and measurement tools have also evolved.

Evolution of Statistical Capacity
The Millennium Summit in 2000 triggered a new conceptual framework for improving official statistics in developing countries. Before the summit, key statistics produced by many developing countries were of poor quality or nonexistent. Domestic resources allocated for statistics were inadequate, limiting the production of censuses and surveys. Technical and financial aid for statistics was almost exclusively bilateral and uncoordinated, often to support specific areas reflecting the priorities of donors, not countries.

The Millennium Declaration called for a new approach to statistical capacity in developing countries to improve development outcomes and track performance. The approach emphasized country-led statistical development plans, monitorable results, and coordinated donor support to address shortcomings in domestic resources for both the supply of and demand for statistics. New global institutions, such as the Partnership in Statistics for Development in the 21st Century (PARIS21) and the UN body to coordinate statistical activities, were established to promote cooperation between the international donor community and statistical producers in developing countries and advocate for improved statistics in key international forums.

The Sustainable Development Goals (SDGs), adopted in 2015, introduced a set of indicators to be produced by NSSs. Global leaders encouraged official statisticians to tap into the exponential

increase in the volume and types of data available to inform their development plans, track performance, and improve government accountability to the public. New global entities, such as the Global Partnership for Sustainable Development Data and the SDSN Thematic Research Network on Data and Statistics, fostered collaborations between official and nongovernmental data producers. The expectations for official statisticians to abide by open data policies also increased.

As a result of these initiatives, measures of statistical capacity, openness, and funding modestly increased.[1] The expanding requirements on NSSs to tap new data sources, find ways to make data more accessible, and expand their measures of development outpaced capacity improvements, however, reinforcing the need for NSSs to continually engage with users—particularly state actors—to ensure that capacity improvements are made in the areas vital to fostering better development outcomes.

The UN High-Level Group for the Modernization of Official Statistics identifies trends, threats, and opportunities to modernize NSSs. For more than a decade, it has overseen the development of standards and models for describing statistical production processes, organizational structures, and metadata (UNECE 2020b). It has provided guidance on communication and relationship management with users, integrating data from varied sources, big data, and managing partnerships and human resources. Operations in many high-performing NSSs now conform to its standards and guidelines and develop a culture of experimentation and innovation.

Measures of Statistical Capacity
Statistical capacity is difficult to measure because it is only partially revealed by achievements or other observable characteristics of the NSS. A system may have the capacity to produce good-quality data but not have yet done so, or it may no longer have the capacity to produce good data despite having done so in the past.

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[1] The Statistical Capacity Building Indicator (established by the World Bank in 2004) increased by about 2 percent between 2004 to 2017 (World Bank 2020b). The Open Data Inventory Index, which assesses the coverage and openness of official statistics, increased by 9.4 points between 2016 and 2020 (ODW 2020). Total funding commitments to statistics more than tripled between 2014 and 2017, rising from $214 million (0.14 percent official development assistance) to $689 million (0.34%) (PARIS21 2019). There is also some anecdotal evidence that domestic resources in low-income countries increased in recent years (GPSDD 2019).

A number of indicators have been developed for measuring statistical capacity (PARIS21 2017c). Most of these measures are based on data collected directly from the staff of national statistical offices (NSOs) or local experts. Although this procedure may provide more in-depth analysis and uncover finer details about the organization of an NSS, it is more expensive and far more time-consuming than measures that are publicly available and easy to access.[2] In addition, these labor-intensive assessments are conducted at the request of the NSS. As such, they are infrequent and cannot be used to track country-specific or global trends in statistical capacity.

To overcome these deficiencies, the World Bank launched the Statistical Capacity Building Indicator (SCBI) in 2004. The SCBI is based on objective indicators that can be updated annually for all emerging market and developing countries (but not for developed countries). International and national agencies have adopted it to measure progress in statistical capacity building and related investments (World Bank 2020b).

Since the launch of the SCBI, its methodology and coverage have remained unchanged despite the marked changes in the data landscape. Open data agendas have propagated; both high- and low-capacity NSSs are modernizing. The SCBI does not capture these advances. Its lack of coverage of high-capacity NSSs means that it is not possible to track advances across the full spectrum of countries.

This paper uses the World Bank's Statistical Performance Index (SPI), designed to assess a country's statistical capacity, to identify areas for improvement in NSSs and to monitor the progress of reforms in statistical capacity building. This index was developed to address the limitations in the SCBI and facilitate intertemporal and intercountry comparisons.[3]

The SPI uses publicly available data on a set of readily observable and verifiable indicators. It provides internationally comparable, objective, country-level assessments across the globe. It views statistical capacity as the range of products and processes an NSS uses to produce and disseminate data.

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[2] Even the best evaluator can bring personal biases, nonuniform conceptions of capacity, or other subjective elements. Interviewing government officials might bias responses and complicate comparability across countries.

[3] The World Bank SPI by Dang, Pullinger, Serajuddin, Stacy (2021) used in this paper for the analysis was an extension of one developed by Cameron et al. (2020).

The index measures five dimensions:

1. *Data Use* pillar assess a range of services that connect data users and producers and facilitates dialogue between them.
2. *Data Services* pillar provide an indicator of the quality of data releases, the richness and openness of online access, the effectiveness of advisory and analytical services related to statistics and the availability and use of data access services such as secure microdata access.
3. *Data Products* pillar assess how well the NSS covers the social, economic, environmental and institutional domains of the Sustainable Development Goals.
4. *Data Source* pillar reflects the availability and frequency of major censuses and surveys mandated by national statistical acts as well as sources of data that are produced outside the NSS, such as administrative data, geospatial data, private sector data and citizen generated data.
5. *Data Infrastructure* pillar represents the institutional framework for the statistical system and includes legislation, governance, standards and methods, skills within the statistical system and among the users, and partnerships.

The SPI is constructed as an equally weighted sum of these five components. Each component consists of a set of categorical variables that ensure that the SPI is additively decomposable by subsets of variables and by subsets of countries (or regions). The total SPI score and the scores of each of the four components range from 0 to 1.

The SPI has four main advantages over the SCBI:

- It includes richer and more comprehensive dimensions, covering aspects ranging from data generation, curation, and dissemination to data analysis.
- It has 51 indicators versus 25 in the SCBIs.
- It covers more than 200 countries. The SBCI covers fewer than 150 countries and includes no high-income countries.
- The SPI is built on a conceptual and theoretical framework. The theoretical principles of the SCI are not clearly formulated.

Because this paper focuses on the demand side, we assess a broad array of variables that influence the demands for national statistics and have dropped the SPI's first pillar – Data Use from our analysis, given filling data gaps in the Data Use pillar underlying the SPI remains a work in progress.[4] For the remainder of the paper, we use this modified SPI comprised of the four remaining pillars that represent the supply-side activities related to NSS performance.

3. What the SPI Reveals

One key improvement of the SPI over the SCBI is its ability to measure statistical capacity through a robust, internally consistent index score for any country in the world. For the first time, we can compare the strengths of well-regarded NSSs with the less-developed institutions in lower- and middle-income countries. With SPI scores available for the full spectrum of countries, we have a measure of the difference between low- and high-income countries in terms of their capability to produce and disseminate statistical products and services.

Figure 1 shows the histogram and nonparametric estimation of the four-pillar SPI's density function for the sample of 215 countries. The distribution appears to be bimodal, with a group of high-capacity countries with SPIs falling in the range from 0.8 to 0.9. The remaining countries center on an SPI of 0.5. Few countries score between 0.62 and 0.75, suggesting that a discrete step may be necessary to reach the group of high-performing countries.

A cluster analysis of the four-pillar SPI scores indicates the presence of a stable cluster of 26 high-capacity counties with a mean SPI of 0.84 and another stable cluster of 30 low-performing counties with a mean SPI of 0.14. No clusters are identified in the region of 0.64–0.79, even when the number of clusters reaches 15.[5] This "statistical performance gap" is analogous to the concept of the middle-income trap in the development economics literature (see Gill and Kharas 2007).[6] A similar gap between the top-performing NSSs and the rest of the world is evident in the Open Data

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[4] See World Bank (2021).

[5] We used the Stata cluster *kmean* routine to perform this analysis (StataCorp 2019).

[6] The term *middle-income trap* refers to countries that experienced rapid growth and quickly reached middle-income status but then failed to catch up to high-income countries. Statistical capacity may exhibit the same phenomenon. The SPI, the first capacity building indicator to measure all countries, is in its infancy. It will be some years before there are sufficient time series data to robustly test the statistical performance gap hypothesis.

Inventory (ODIN) index, which assesses the coverage and openness of the systems of official statistics in 187 countries (ODW 2020).

Heterogeneity in the distribution of the four-pillar SPI used here confirms the findings and recommendation of the report on national accounts conducted by the World Bank (World Bank 2008). That study concluded that "the range of developing countries is extensive, some close to economic sophistication and statistical resources to OECD countries. At the other end of the range, however, are countries with relatively small populations, economies that are concentrated in a few areas with a limited number of skilled professionals." The guide recognized that some recommendations of the report have little effect for countries that lack other features, such as sophisticated financial markets.

The International Monetary Fund (IMF) uses different standards for the collection and provision of macro-statistics for countries that "play the leading role in international capital markets" and the rest of the world (IMF 2020). Hoogeveen and Pape (2020) emphasize that data demands in fragile states differ greatly from demands in countries where granular statistics on income, for example, are essential for maintaining an array of social and employment programs.

Figure 2 plots the coefficient of variation (CV) in the SPI components against the SPI for each country in the sample.[7] The CV shows the degree of dispersion of the SPI components in a country. The maximum CV is reached when only one of the four SPI components is different from zero; the minimum CV corresponds to cases when all four components are equal.

For our sample, the CV of the SPI components decreases with the aggregate SPI. Countries with the highest SPI have the smallest CV of their SPI components (in other words, top performers are good at every dimension of the SPI). Australia, for example, has an aggregate SPI of 0.85. The Data Services pillar is 0.92, the Data Product and the Data Source components are both 0.74 and Data Infrastructure pillar are 1.0 (the highest possible value).

At the other end of the CV spectrum are countries with low SPIs. These countries have very different scores on their SPI components and thus high CVs. Madagascar, for example, has a low

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[7] $CV = \sqrt{\frac{\Sigma_i(x_i-\mu)^2}{n-1}}/\mu$, where μ is the mean value of four SPI component for a country and x_i is the value of a particular component of the SPI.

Data Source (0.12), and Data Infrastructure (0.3), and a relatively high Data Services (0.56) and Data Products (0.61) components. Senegal is in the middle range in terms of the SPI distribution and CV spectrum (SPI = 0.56), with uneven performance of individual components. The components of SPI increase from a low of 0.4 for Data Infrastructure and Data Sources components to 0.67 for Data Products, and 0.81 for Data Services.

That pattern of variance of four SPI components, or pillars, may be explained by weak donor coordination in statistical capacity building and donors' preferences for certain areas of the NSS. It is also likely that resource-constrained countries cannot effectively allocate resources to cover all dimensions of the SPI. The high variance in SPI components among low-capacity countries hinders their progress because components of SPI complement one another in the production and dissemination of statistical information. For example, a weak capacity to collect survey and census data adversely affects the presence of key indicators in international databases.

Figure 3 reinforces the argument that donor preferences could be driving capacity improvements in low-performing countries. Data Infrastructure and Data Products are the largest contributors to the overall SPI scores for this group; until recently, they were donors' preferred statistical tool, as they contribute to understanding social rather than economic performance. Low scores on Data Services and Data Sources, which are more developed for economic than social statistics, reinforce this hypothesis.

4. Assessing the Demand for Data

We assume that in the long run, a country's statistical capacity is determined by the interaction between the supply of and demand for data. If the demand for official statistics exceeds the supply, data users will pressure the government to increase investment in the NSS. If the NSS supplies more data than are consumed, the government will eventually reallocate resources to more urgent priorities. The steady-state equilibrium of the statical capacity is reached when the demand for data corresponds to its supply.

The government's funding preferences for NSSs are formulated based primarily on whether the NSS mobilizes the power of data to help these actors make better decisions. However, by disseminating high-quality products, the NSS has the potential to reshape state capacity (Taylor 2016). Better data from the NSS lead to improved state services. This virtuous cycle is likely left

out of government funding allocations. Although the supply of and demand for data may fluctuate in the short run, gaps between demand and supply erode the long-run sustainability of an NSS.

Canada's chief statistician, Ivan Fellegi, argues that "the greater the authority of the chief statistician, the more important it is to have a variety of mechanisms through which the different needs of different client groups can be determined" (Fellegi 1995). Assessments of NSSs in the Organisation for Economic Co-operation and Development (OECD) identify deficiencies in understanding evolving user needs (PACAC 2019; APAC 2020). Similar deficiencies are found in low- and middle-income NSSs. An AIDDATA survey of policy makers, government technocrats, and NSS staff found that the most important and frequent users of statistics were international organizations and development partners, not domestic users (Sethi and Prakash 2018).

The four supply side pillars of the SPI are a good proxy for the NSS's capacity to produce and disseminate a range of data products. The empirical model presented here aims to proxy the demand for official statistics. It draws on the same criteria underlying the SPI.[8] Our empirical approach is derived from the literature on inferring the "social efficiency" of economic indicators by the measured deviation of these indicators from the efficiency frontier (e.g., Sen 1981; Moore et al. 2000; Wang et al. 1999). The efficiency frontier is identified from the residual of a regression of an indicator of interest (in our case, the SPI) on a set of control variables, a methodology sometimes referred to as benchmarking (Ravallion 2005).

Empirical Model

Our empirical model relates the values of the SPI index and its pillars with the variables that may determine a country's demand for and supply of statistical data. This reduced-form model is represented in the following form:

$$SPI_{i,k} = \beta_1 Log(GDP)_i + \beta_2 ECI_i + \beta_3 Pop_i + \beta_4 SUR_i + \beta_5 EDU_i + \beta_6 VA_i + \beta_7 FRG_i +$$
$$+\pi Reg_{i,j} + \epsilon_i \ (k = 0, \dots, 4; j = 1, \dots, 7) , \quad (1)$$

where $SPI_{i,0}$ is the SPI for country i; $SPI_{i,1\dots4}$ are the four supply side pillars of the SPI; and $Log(GDP)_i$ represents the log of GDP of country i. We expect richer countries to spend more on

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[8] The criteria are as follows: *Simple*: It must be understandable and easy to describe. *Coherent*: It must conform to a common-sense notion of what is being measured; *Motivated*: It must fit the purpose for which it is being developed. *Rigorous*: It must be technically solid. *Implementable*: It must be operationally viable. *Replicable*: It must be easily replicable. *Incentive consistent*: It must respect country incentives.

statistical capacity and have higher values for the SPI and its components. The economic complexity index (ECI_i) measures the productive capabilities of an economic system (its integration into global value chains). More complex economies require more data to manage and operate successfully, which should increase both the demand for and supply of statistical services. Economies of scale in the production of statistical information are captured by the country's population (Pop_i). Economies of scale in large countries arise from the fixed costs of setting up statistical operations, which may vary little with the size of the country (e.g., De Vries 1999).

The demand for statistical information is linked to the level of education in the country (EDU_i). The ability to read and interpret the data published by national statistical offices depends on the levels of statistical literacy and numeracy in a county (Schield 2011). We, therefore, expect countries with larger shares of educated people to have higher SPI scores. The share of the urban population (SUR_i) captures the structure of the economy, which could also affect demand for data. We use the voice and accountability indicator (VA_i) to control for the role of civil society as consumers of official statistics (Gray, Lämmerhirt, and Bounegru 2016). The fragility index ($FRG_{i,}$) accounts for the state of fragility and conflict in the country. The model also includes seven regional dummies to control for regional cooperation and knowledge transfer across NSOs.

Data

We use several sources of data. The first is the SPI and its component. In our sample, it ranges from 0.21 (Papua New Guinea) to 096 for (Australia).

An indicator of voice and accountability comes from the World Governance Indicators (WGI) database, produced by the World Bank annually since 1996 for over 200 countries (Kaufmann et al. 2010). This indicator ranges from –2.5 (lowest) to 2.5 (highest).

We control for a country's secondary enrollment rates and GDP per capita (in constant 2011 purchasing power parity dollars) using data from the World Development Indicators database (World Bank 2020a) and information from other sources. We use the economic complexity index at the MIT Lab and Harvard University (Hausman and Hidalgo 2012). We include the country fragility index produced by the Center for Systemic Peace in the State Fragility Index and Matrix (2018) data set (Marshall and Cole 2018). It ranges from 0 to 24, with higher values indicating greater state fragility. Table 1 displays the descriptive statistics for our main variables.

Results

Table 2 shows the results of the OLS regression of model (1) for the aggregate SPI. The estimation based on specification (1) reveals that the SPI is positively and significantly correlated with the economic complexity index. More economically complex countries have better-performing NSSs. Countries with more educated populations and countries with more developed civil society (as measured by the voice and accountability index) also tend to have higher SPIs. Overall, the regression in specification (1) demonstrates the high explanatory power of our model, which explains more than 70 percent of cross-country variation in the SPI (adjusted R^2 of 0.716).

Specification (2) expands the set of explanatory variables by adding a set of regional dummies. These dummies account for potential cooperation and knowledge transfer among countries in some regions. The coefficients on the regional dummies demonstrate that NSOs in the Middle East and North Africa, South Asia, and Sub-Saharan Africa do not perform as well as NSOs in Europe and Central Asia. NSOs in the United States and Canada, and East Asia have SPIs similar to those in Europe. The other variables in the model have effects similar to those in specification (1). Coefficients on the economic complexity index, education, and voice and accountability are positive and significant.

In Table 3, we repeat the estimations based on specification (2) in Table 2 for each of the four components of the SPI. For comparability with the coefficients of the SPI regression, we normalized the SPI components to be between 0 and 1. The regression of MSC component is similar to that of the SPI (first column in Table 3). Economic complexity, voice and accountability, and education all have positive effects on this component. Canada and the United States have MSC values that are similar to those for European countries. The explanatory power of the MSC regression is also similar to that of the SPI regression (adjusted R^2 of 0.740).

The CS regression has a positive and significant coefficient on the economic complexity index and the voice and accountability indicator. In contrast with the MSC regression, the CS estimation produces significant coefficients on the fragility index, and the coefficient on the secondary school enrollment variable loses significance. The CS estimation demonstrates much narrower regional differences. Controlling for other covariates, scores on this component are significantly lower than average only in Sub-Saharan Africa.

The coefficients on population size and school enrollment are positive and significant in the AKI regression. This indicator is higher in the United States and Canada than in countries in other regions. The AKI regression has less explanatory power than the SPI, MSC, and CS regressions, with an adjusted R^2 of only 0.445.

The DPO regression shows the positive impact of economic complexity and the level of education. Unlike other regressions and the findings by ODW (2020), the DPO component is negatively correlated with the log of per capita GDP. The regional effects are consistent with regression results for other components; The NSSs of the United States and Canada have better dissemination practices and greater openness than the statistical agencies of other regions.

Figure 4 shows the scatter plot of the actual and predicted values of SPI (based on the regression in Table 2). The predicted SPI reflects the potential equilibrium supply of statistical information that a country should have, given its characteristics. Because at equilibrium, the supply of data should correspond to the demand for data, we interpret the difference between the observed and predicted SPIs as the difference between the supply of and demand for data.

The regression of the SPI has strong explanatory power, which is evident from the tight distribution of countries around the 45-degree line. That line separates countries into two zones. In countries above the 45-degree line, the predicted SPI is larger than the actual SPI. Given these countries' characteristics, their NSSs undersupply data to data consumers, both domestic and international. The NSSs of countries below the 45-degree line oversupply data, given the profiles and characteristics of their data users.

Figure 5 presents a cut-out of the rectangle in Figure 4. The SPI of the NSO of one of the rich countries (ORC) is comparable (actual SPI = 0.43) to the SPI of Nicaragua (NIC), a country with a per capita GDP at least 15 times lower (about $1,700). The economic complexity, GDP per capita, and level of education in this rich country indicate that the demand for data there exceeds the supply and that its NSO should perform at the level of Oman (predicted SPI = 0.50). The SPI of the National Institute of Statistics of Guatemala is similar to that of the NSO in El Salvador (actual SPI = 0.57). The predicted SPI of 0.51 places Guatemala's NSO close to the NSO of Bangladesh.

In Figures 4 and 5, NSOs above the 45° line undersupply data, NSOs near the 45° line meet the demand for data, and NSOs below the 45° line oversupply data, given the characteristics of their countries. We discuss different capacity-building strategies for these three groups of countries in the next section.

Our econometric approach could be criticized from multiple perspectives. The coefficients of our regressions could be biased because of reverse causality. One could argue, for example, that poor statistical performance negatively affects a country's GDP or prevents it from becoming part of global value chains, reducing economic complexity. Although these concerns have merit, we think that statistical performance in many developing countries is sufficiently weak that it reflects rather than causes the factors we examine.

Some unobserved factors could affect both the SPI and our independent variables. Given our data limitation, we see no way to address such a bias. Once the next round of SPI data becomes available, some of these concerns could be addressed.

We replicate our analysis on the earlier version of SPI developed by Cameron et al. (2021). Given the commonalities in design, both the SPI and the earlier version of the index are highly correlated (Figure A in the Appendix) and the analysis generates qualitatively similar results.[9] The similarity of the two sets of results provides a degree of confidence in the robustness of our main conclusions.

5. Discussion

Our findings suggest three questions that could stimulate the discussion about building sustainable statistical capacity in developing countries.

Question 1: Should technical assistance delivery mechanisms change, given the marked difference between the cluster of high-supply/high-demand countries and the rest of the world described in Figure 1?
Over the past two decades, high-performing NSSs have provided much of the technical expertise to improve developing countries' statistics. The organization, technology, and data sources of high-performing NSSs are drastically different from those of the rest of the world, however. High-capacity countries have long been adapting their statistical production processes to accommodate the ever-expanding set of administrative data that have become the foundation of many statistical

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[9] The results of this analysis are available from the authors on request.

products. For example, Denmark's 1976 population census relied on a population register, a business register, and a set of tax registers (Jensen 1983). By contrast, administrative data in lower-capacity countries are just beginning to become available for statistics.

High-capacity NSSs use a variety of big data applications to official statistics.[10] With more sophisticated production processes that deliver a wider array of statistics, staff in high-capacity NSSs are highly specialized. For example, dedicated teams develop supply-use tables, the foundation for rebasing GDP estimates. In contrast, lower-capacity NSSs produce supply-use tables less frequently, and the work is done by nondedicated teams. Unlike lower-capacity NSSs, higher-capacity NSSs also have staff devoted to developing analytical and innovative products.

These and other differences suggest that technical assistance works best when high-capacity advisors are familiar with the circumstances in low-capacity environments. The IMF Regional Technical Advisory Centers provide a range of statistical support to developing countries. In 2016, they delivered 563 technical assistance (TA) products and 120 training events (IMF 2016). These centers are typically staffed by statisticians with long experience in high-performing NSSs, who coordinate efforts and sensitize foreign experts to local circumstances. Relocating these statisticians to immerse them in the working circumstances in their countries likely results in better advice and more sustainable outcomes. Leading bilateral providers of TA are adopting a similar approach. The presence of in-country strategic advisors has helped improve donor coordination on NSSs and sensitize experts with little experience in low-capacity environments (UK Foreign, Commonwealth, and Development Office 2020).

The gap between the cluster of high-performing NSSs and the rest of the world shown in Figures 1 and 2 also suggests that expanding South–South knowledge exchange could improve the impact of capacity building. Cooperation among developing countries is not new. The Statistical, Economic, and Social Research and Training Center for Islamic Countries (SESRIC) and AFRISTAT are examples of capacity-building programs for member states. Broadening South–South support to improve official statistics remains relevant in the face of common new challenges faced in lower-capacity NSSs.

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[10] For examples from Statistics Netherlands, see https://www.cbs.nl/en-gb.

Question 2: What factors contribute to the high dispersion across the four dimensions of the SPI in low-performing countries and the slow convergence to the fully capable systems in place in high-performing countries?

Donor coordination in statistical capacity building is weak. A 2020 report by the OECD Development Assistance Committee (DAC) noted that "challenges relating to donor coordination and alignment with country priorities can often be explained by a combination of weak in-country demand for data and statistics, unclear priorities, along with tensions created by strong donor demand for specific data and statistics for program design, targeting, monitoring and results reporting."

Only half of DAC members make the country's national strategy for the development of statistics the basis for their engagement. Donors are more likely to invest in point-in-time data sources, such as household surveys, that provide ready-to-use data quickly, with minimal cost overruns. Household surveys are not necessarily conducive to developing sustainable statistical capacity, however, because "the role of the NSO is often reduced to recruiting and fielding enumerations while questionnaire designs are standardized and analyzed by development agencies." In addition, only 16 percent of low-capacity NSOs cited these surveys as a strategic priority.

Donors' poorly coordinated and survey-centric approach to country support increases scores in one dimension of the SPI (Census and Surveys) but pays little regard to the other three dimensions. It also means that NSSs accept external support if it brings additional funding. As countries become better at understanding (and stimulating) user demands, they are more likely to increase domestic funding for their work, which should strengthen all four SPI dimensions.

Question 3: Should capacity-building strategies better reflect the fact that many countries are providing too little data given users' needs, as highlighted in Figure 4?

An important implication of our theoretical framework is the existence of a steady-state equilibrium of statistical capacity that is determined by the supply of and demand for data. This equilibrium shifts in response to changes in the demand for data or changes in the technology of data production (Solow 1956).

Similar to the turnpike theorem (McKenzie 1986), we assume that there exists an efficient and optimal path for statistical capacity building. If the goal of statistical capacity building is far from the current state of the NSS, it is optimal for a country to expand its statistical capacity along the

growth path that balances demand for and supply of data. McKenzie (1986) provides intuition for this result:

> [It] is exactly like a turnpike paralleled by a network of minor roads. There is a fastest route between any two points; and if the origin and destination are close together and far from the turnpike, the best route may not touch the turnpike. But if origin and destination are far enough apart, it will always pay to get on to the turnpike and cover distance at the best rate of travel, even if this means adding a little mileage at either end (McKenzie 1986).

While the paths of statistical capacity growth vary by country, these individual paths converge to the optimal trajectory of the benchmarks of a stationary growth process.

Figure 6 describes potential paths for improving the capacity of two hypothetical countries. Country XYZ suffers from a statistical deficit. Country ABC supplies more data than data users can consume.

Conventional broad-based strategies—following the country's national strategy for the development of statistics, for example—often aim to improve capacity along the line from point 1 to point 3. These strategies address deficiencies in legal and institutional frameworks, human resources, infrastructure, and statistical operations in order to improve statistics across a wide array of topics. However, the conventional strategy often lacks a clear picture of domestic development priorities and the government's capacity (and willingness) to act on evidence.

Developing a greater understanding of the state of a country's policy priorities and policy formulation capacity allows NSS strategies to follow a two-step path. Country XYZ could first focus on improvements that align its data supply with policy capacities, the line from point 1 to point 2. Step 1 moves the country to the statistical capacity optimal growth path. This step would result in an NSS that supplies statistics that address the country's current data needs and analytic abilities to use them.[11] Point 2 is on the statistics supply-demand equilibrium—the short-term steady-state, given the country's current characteristics, reflected by the 45-degree line.

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[11] NSSs should aim to slightly oversupply country demands, to reflect the "endogenous growth" role of data to the economy. Data are a foundation of the knowledge that is essential for economic transformation. However, it is difficult to measure data's contribution to growth and thus reflect it in NSS capacity-improvement plans.

Once the country's production of statistics meets existing country demands, capacity-building strategies should aim to align statistical products and services as the country's data needs evolve (movement along the optimal expansion path). As the country's data requirements expand (i.e., move along the 45-degree line away from the origin), statistical capacity should move from point 2 to point 3 (step 2). Aligning NSS capacities to meet evolving needs and policy capabilities is a challenge. Higher levels of policy capability will require a broader set of statistics at more fine-grained levels of detail. Strategies will need to focus on how user needs are evolving and identify data production processes that can adapt to meet these needs.

Two developments in the literature could help implement the two-step path. The first is the framework for tracking the evolution of user demands (UNECE 2019a, 2019b). This work recognizes the strategic and operational approaches to managing the user relationship. In the strategic approach, NSS management participates in meetings with leaders of government institutions, represents the NSS at international meetings, and/or participates in other high-profile meetings. The operational approach involves establishing and maintaining relationships with statistical experts at other institutions. The UNECE framework also emphasizes the importance of user segmentation in engagement strategies.

The second is the general framework for assessing a government's policy development capacity, as described in Wu, Howlett, and Ramesh (2015) This framework includes a skill dimension (analytical competencies, managerial competencies, political competencies) and a resource dimension (individual capabilities, organizational capabilities, and system capabilities) that can be useful in determining how to align NSS improvement priorities with policy-making capabilities.

Countries may oversupply statistics for three reasons:

- In countries with a weak ability to control donors, donors may increase supply to meet their own needs.
- Oversupply may reflect strategies to overshoot demand in order to provide sufficient flexibility to adapt to user needs.
- Oversupply may be temporary, as aspects of improvements are discrete. For example, an NSS may have recently invested in systems to facilitate the dissemination of statistical products that outstrip current demand.

For a country that oversupplies statistics, such as country ABC in Figure 5, capacity-building strategies should ensure that supply remains above demand as the country evolves.

6. Conclusion

In this paper, we propose an approach to operationalizing the newly developed Statistical Performance Indicator (SPI) as an instrument to guide the development of statistical capacity-building strategies in developing countries. Our analysis of the distribution of the SPI and its components over a sample of 215 countries uncovers several important results.

The distribution of SPI scores appears to be bimodal, with two distinct clusters (of low- and high-performing NSSs) separated by a wide gap in SPI scores—a situation similar to the middle-income trap phenomenon in economic development. Poorly performing NSSs have high variance across the four components of the SPI. Because of the interdependence of the SPI components in the production and dissemination of statistical products, the disparity in the levels of individual components hampers the ability of NSSs to deliver services.

Our regression analysis reveals that a country's per capita GDP, the complexity index, the level of education of the population, and regional characteristics are good proxies for the country's demand for data. Comparing the measured supply of data with the predicted demand for data shows three types of NSSs: NSSs that undersupply data, oversupply data, or produce the right amount of data. These three groups motivate our two-step strategy of building and enhancing the sustainable statistical capacity of NSSs in developing countries.

Our main proposal is to align capacity-building activities to the data priorities expressed by local actors and their capability to act on these data. NSSs that undersupply data should first bring their data production and dissemination practices in line with their country characteristics. After they do so, they should evolve their operations by monitoring and responding to changing demands for their products. Only when the supply of data corresponds to the demand for data are operations sustainable in the long term.

Coordination within the donor community and South–South learning and experience exchange initiatives are critical to increasing the statistical capacity of NSSs. Such coordination can help countries that reached middle-capacity status but have not graduated to the pool of top NSSs bridge the "statistical performance gap."

Future empirical analysis would benefit from using annual data on the SPI. A panel data set of SPI would allow researchers to refine the estimates of demand for and supply of data by controlling for country-specific, unobservable effects that might be correlated with statistical performance.

The results of our findings should be treated as the first step of this analysis. More in-depth research that relies on detailed country data is required to understand the interplay between the supply of and demand for data in determining the capacity of an NSS. We hope this paper will stimulate research on the optimal path for improving statistical capacity in developing countries.

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Figure 1: Histogram and nonparametric density function of the Statistical Performance Indicator (SPI)
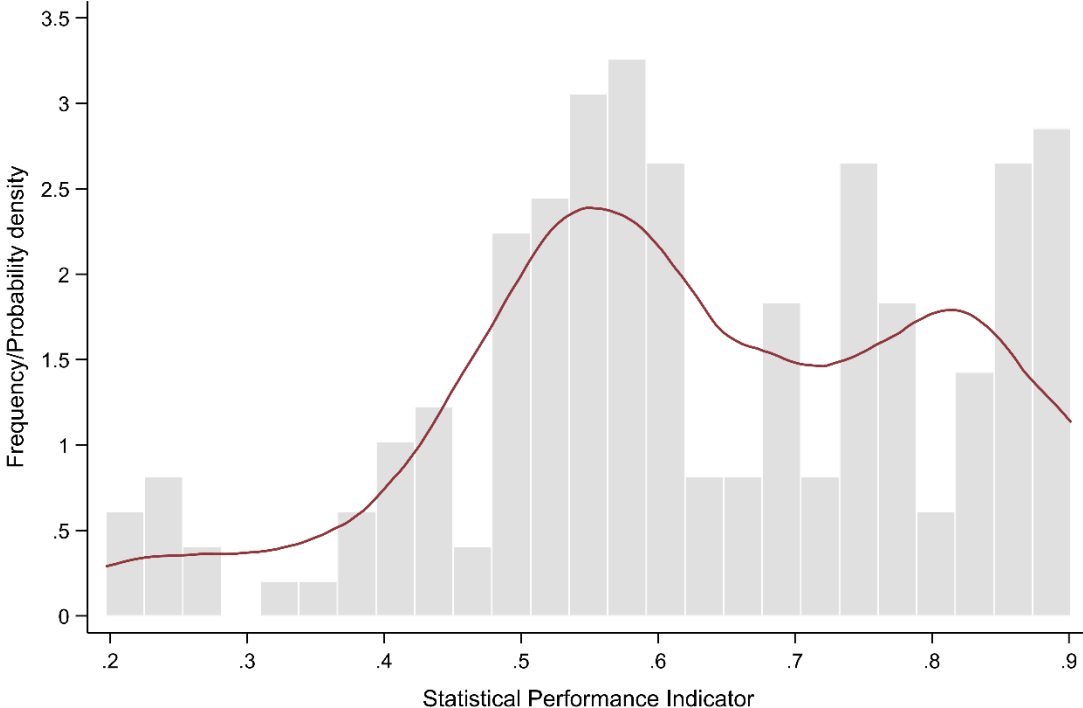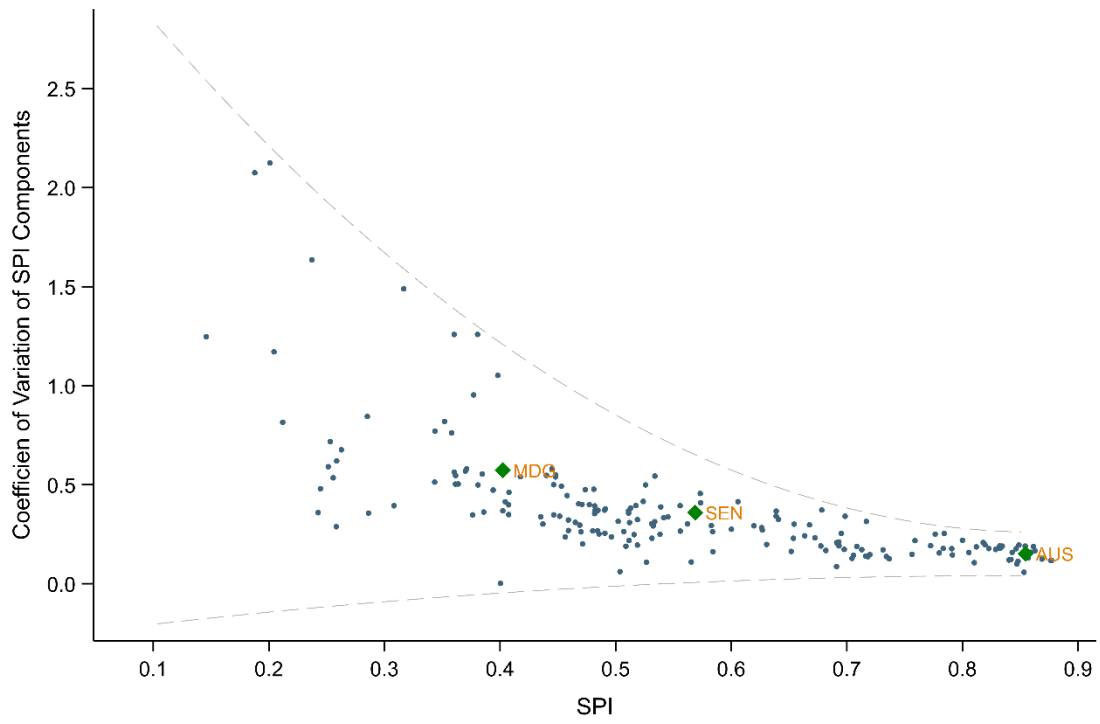
Figure 2: Coefficient of variation of the SPI components versus the SPI

Note: Country ISO3 abbreviations: MDG = Madagascar, EGY = Egypt, AUS = Australia.

Figure 3: Shares of SPI components by SPI
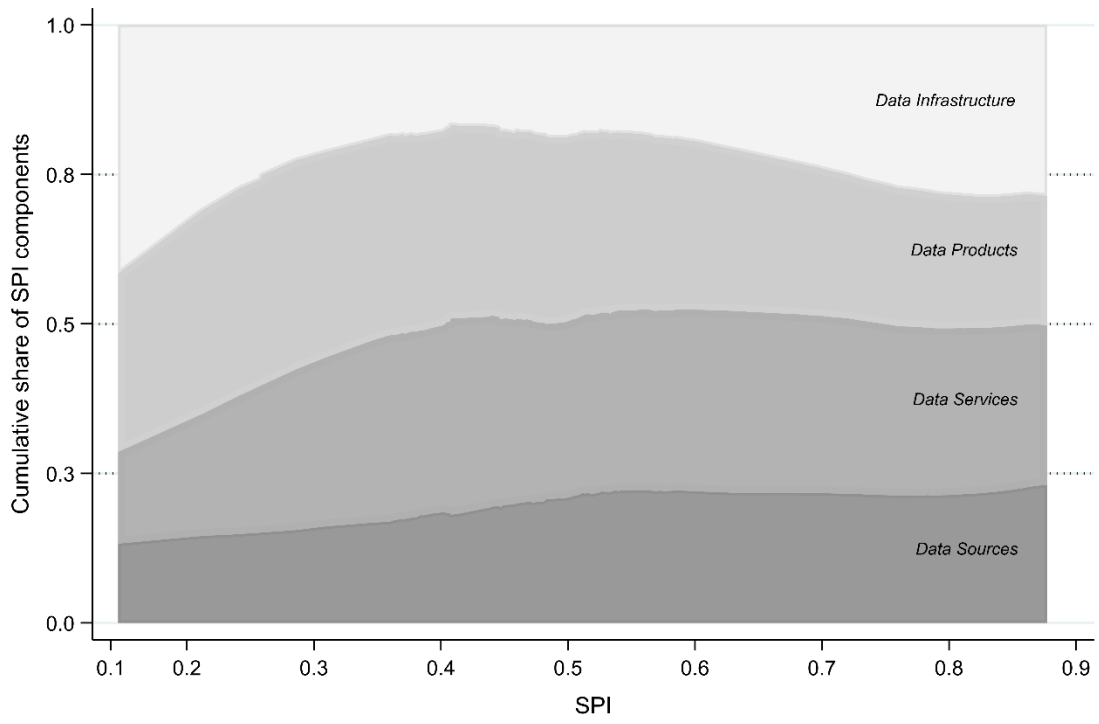
Figure 4: Predicated versus actual Statistical Performance Indicator (SPI)
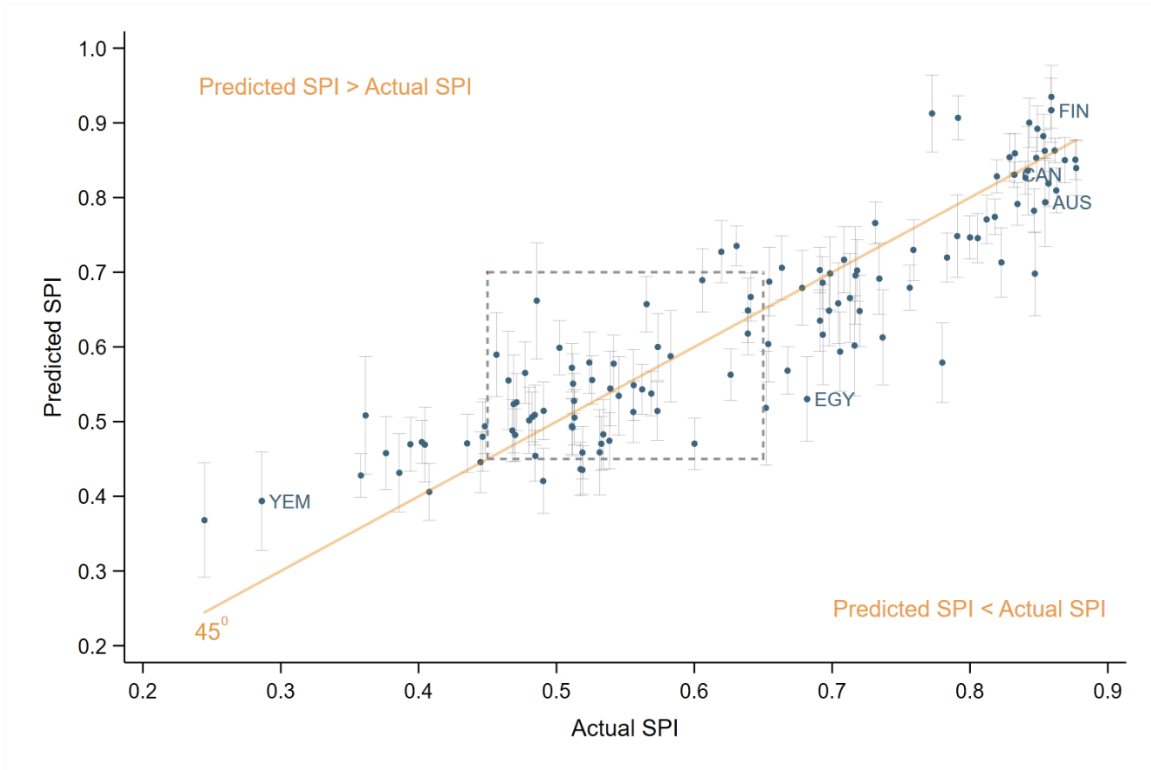
Note: Country ISO3 abbreviations: YEM = Yemen, EGY = Egypt, FIN = Finland, CAN = Canada, AUS = Australia.
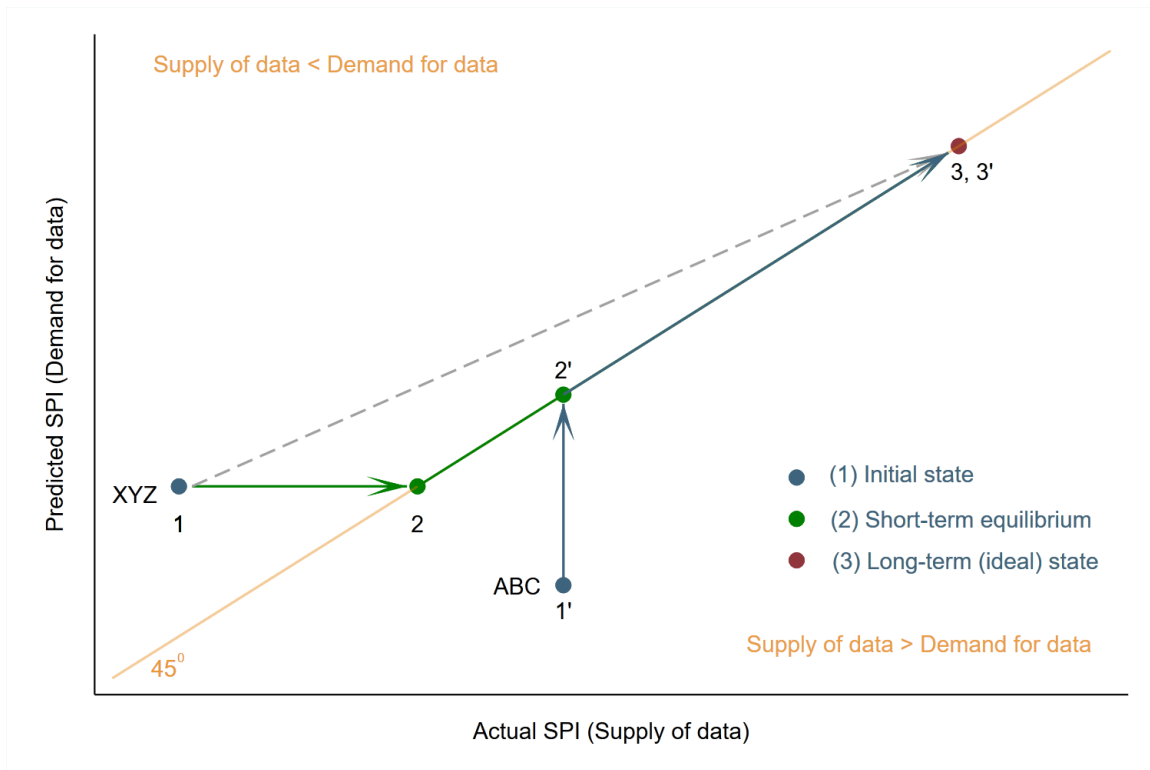
Figure 5: Predicated versus actual Statistical Performance Indicator (SPI) in selected countries
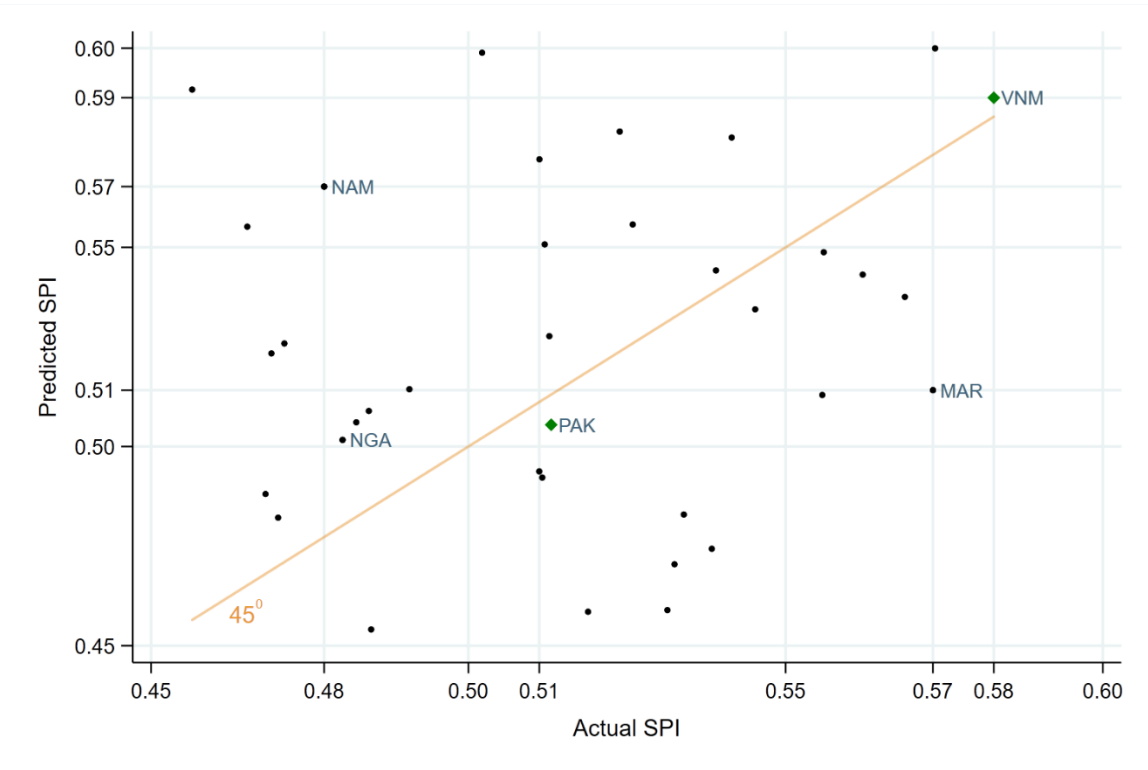
Note: High resolution cut-out (dash-line rectangle) from Figure 4. Country ISO3 abbreviations: NAM= Namibia, NGA = Nigeria, PAK = Pakistan, MAR = Morocco, VNM= Vietnam

Figure 6: Strategies for improving statistical capacity

Note: Hypothetical country XYZ suffers from a statistical deficit. Hypothetical country ABC supplies more data than data users can consume. Conventional strategies often aim to improve the capacity of XYZ along the line from point 1 to point 3. Alternatively, the country could first focus on improvements that align data supply with policy capacities, moving along the line from point 1 to point 2. Then, as the country's data requirements expand, statistical capacity should move from point 2 to point 3. Country ABC that oversupplies statistics should aim to ensure that supply of data remains above demand as the country evolves, moving from 1' to 2' to 3'.

Table 1: Descriptive statistics for dependent and main independent variables

Variable	Mean	Standard deviation	Minimum	Maximum	Data source
Dependent variables					
Statistical Performance Indicator (SPI)	0.630	0.163	0.146	0.877	0.630
Pillars of SPI					
Data services	0.729	0.191	0.006	1.000	0.729
Data products	0.666	0.110	0.408	0.906	0.666
Data sources	0.543	0.179	0.117	0.875	0.543
Data Infrastructure	0.582	0.294	0.050	1.000	0.582
Controls					
Log GDP per capita	9.479	1.072	7.051	11.637	WDI
Economic Complexity Index	0.054	0.978	−1.897	2.427	MIT
Population (millions)	0.561	1.770	0.012	13.864	WDI
Share of urban population	62.760	21.044	13.102	100.000	WDI
Secondary school enrollment (gross)	88.823	28.897	19.930	158.542	WDI
Voice and accountability	−0.002	0.967	−2.159	1.692	WGI
Fragility index	6.602	5.255	0.000	21.000	SFIM
Regional dummies					
Europe and Central Asia	0.350	0.479	0	1	WB
East Asia	0.122	0.329	0	1	WB
Latin America	0.163	0.371	0	1	WB
Middle East and North Africa	0.122	0.329	0	1	WB
United States and Canada	0.016	0.127	0	1	WB
South Asia	0.033	0.178	0	1	WB
Sub-Saharan Africa	0.195	0.398	0	1	WB

Source: Authors' calculations.

Note: WB = World Bank; WDI = World Development Indicators database. MIT = Massachusetts Institute of Technology. WGI = World Governance Indicator database; SFIM = State Fragility Index and Matrix data set.

Item	(1) Coefficient	Standard Error	(2) Coefficient	Standard Error
Controls				
Log GDP per capita	0.006	*0.017*	0.005	*0.018*
Economic Complexity Index	0.054***	*0.012*	0.038***	*0.014*
Log population	0.015**	*0.006*	0.019***	*0.006*
Share of urban population	-0.001*	*0.001*	-0.000	*0.001*
Secondary school enrollment (gross)	0.002***	*0.000*	0.001***	*0.000*
Voice and accountability	0.076***	*0.014*	0.076***	*0.019*
Fragility Index	0.001	*0.003*	0.002	*0.003*
Regional dummies				
Europe and Central Asia		*Reference category*		
East Asia			-0.060**	*0.028*
Latin America			-0.082**	*0.032*
Middle East and North Africa			-0.095**	*0.039*
United States and Canada			-0.027	*0.018*
South Asia			-0.099***	*0.035*
Sub-Saharan Africa			-0.086**	*0.038*
Constant	0.196	*0.159*	0.184	*0.173*
R^2	0.748		0.770	
Number of observations	123		123	

Note: Robust standard errors are used. The reference category for the regional dummies is Europe and Central Asia
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Table 3: Ordinary least squares regression estimations of the components of the Statistical Performance Indicator (SPI)

Item	Data Services Coefficient	Data Services Standard error	Data Products Coefficient	Data Products Standard error	Data Sources Coefficient	Data Sources Standard error	Data Infrastructure Coefficient	Data Infrastructure Standard error
Controls								
Log GDP per capita	-0.011	*0.034*	-0.042**	*0.021*	0.044**	*0.022*	0.030	*0.028*
Economic Complexity index	0.052***	*0.020*	0.016	*0.015*	0.033	*0.021*	0.051*	*0.026*
Population (millions)	0.014	*0.011*	0.024***	*0.008*	0.014	*0.010*	0.025***	*0.009*
Share of urban population	0.000	*0.001*	0.000	*0.001*	-0.001*	*0.001*	0.000	*0.001*
Secondary school enrollment (gross)	0.001**	*0.001*	0.001*	*0.001*	0.002***	*0.001*	0.002**	*0.001*
Voice and accountability	0.122***	*0.027*	0.048***	*0.016*	0.045*	*0.025*	0.091***	*0.028*
Fragility index	0.006	*0.006*	0.001	*0.004*	-0.002	*0.005*	0.004	*0.006*
Regional dummies								
East Asia	0.018	*0.043*	-0.027	*0.033*	-0.009	*0.041*	-0.222***	*0.047*
Latin America	0.007	*0.044*	0.018	*0.036*	-0.004	*0.039*	-0.349***	*0.049*
Middle East and North Africa	0.001	*0.065*	-0.075*	*0.039*	0.012	*0.047*	-0.318***	*0.068*
United States and Canada	-0.016	*0.030*	-0.147***	*0.024*	0.120***	*0.027*	-0.065**	*0.030*
South Asia	0.001	*0.057*	-0.067	*0.063*	0.022	*0.046*	-0.350***	*0.052*
Sub-Saharan Africa	0.018	*0.043*	-0.027	*0.033*	-0.009	*0.041*	-0.222***	*0.047*
Constant	0.427	*0.336*	0.593***	*0.225*	-0.156	*0.197*	-0.128	*0.283*
R^2	0.580		0.375		0.661		0.787	
Number of observations/countries	123		123		123		123	

Note: Robust standard errors are used. For comparison with SPI regression, values of the SPI components were normalized to 0–1. The reference category for the regional dummies is Europe and Central Asia.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Appendix

Figure A: Correlation between Cameron at al. (2021) and the World Bank Statistical
Performance Indicator (SPI)