Measuring Institutional Strength: The Correlates of Growth

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Abstract

This paper examines the strength of domestic institutions using a factor analysis model. By conceptualizing domestic institutions as a latent variable, I explore patterns in institutional strength in low-dimensional space to create an aggregate measure of institutional strength that does not rely on strong econometric assumptions.

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1 Introduction

Beginning in the 1990s, economists have turned to institutions to explain differences in levels and rates of economic growth and output per worker (Hall and Jones (1999), Acemoglu, Johnson and Robinson (2001)). Political scientists, however, have long known that the empirical study of institutions has been a problematic task, since the selection of units (countries with data) is non-random and the assignment of units to treatment (countries with characteristics that encourage economic growth) is non-random. This puts the study of domestic institutions in the category of an observational study which does not allow either causal or population inference without large potential for bias.

Rather than solving the endogenaity problem using instrumental variables estimation, this paper presents an empirical method for estimating the strength of domestic institutions using all available information.

2 Existing perspectives on domestic institutions

Institutions of the sort that contribute to economic growth may be formal (state) institutions or informal institutions (patterns of social behavior).

Formal institutions provide "an environment that supports productive activities and encourages capital accumulation, skill acquisition, invention, and technology transfer." (Hall and Jones (1999)) These factors may include separation of powers, rule of law (an independent judiciary), efficient health care provision, and widely available primary education. As Acemoglu, Johnson and Robinson (2001) note, "Countries with better '*institutions*,' more secure property rights, and less distortionary policies will invest more in physical and human capital and will use the factors more efficiently to achieve a greater level of income." Country characteristics which we normally associated with strong formal institutions are fortunately observable, if difficult to collect. These features include stable political institu-

tions (proxied by the POLITY IV measure), strong rule of law and judicial independence (see Knack and Keefer (1995)), efficient health care provision (measured through public health indicators such as infant mortality and life expectancy), and widely available primary education (measured through educational attainment [see Barro and Lee (2000)], public education expenditure [see Ansell (2004)], or literacy rates).

Informal institutions that contribute to growth include what some scholars call social capital (Putnam, Leonardi and Nanetti (1994)). Social capital is best described as the pareto-improving equilibrium in a prisoner's dilemma game achieved after iterated play. Putnam uses survey data to measure outcomes that arise from a strong stock of social capital. The sort of detailed questionnaires that Putnam relies on to measure stocks of social capital in the United States and Italy are not generally available for a cross section of countries. Indeed, problems with cross-culture comparability may make social capital a difficult thing to measure in a panel of countries.

Political and social institutions are difficult to analyze in the context of growth. Strong institutions mean that a state may feature for example high literacy rates, low infant mortality, and strong rule of law, which may in turn imply high stocks of human capital, a positive population growth rate, and a stable legal framework suitable to sustaining investment over a long time horizon. These latter features reinforce the strength of domestic institutions *and* directly affect the dependent variables of interest – GDP growth or output per worker. In short, institutions are endogenous.

Methodological approaches

The established econometric approach to the endogenous systems (such as the affect of institutions on growth) is instrumental variable estimation. The logic underlying IVE is as follows:

- Let

$$y_i = \beta_0 + \beta_1 X_i + e_i$$

  where the endogenous regressors X_i consist of two parts

  1. The "good" variation (uncorrelated with e_i), and
  2. The "bad" variation (correlated with e_i).

- To separate the variation with explanatory power from the endogenous variation, choose an instrument Z_i that satisfies the following conditions:

  1. The instrument is relevant ($\text{corr}(Z_i, X_i) \neq 0$), and
  2. The instrument is exogenous ($\text{corr}(Z_i, e_i) = 0$).

  Thus, the instrument Z_i is valid if it only affects the dependent variable y_i through the endogenous regressor X_i. (This is also known as the exclusion restriction since Z_i should not affect y_i directly.)

These two requirements have led to heated debates regarding instrumental validity. On one side, the practitioners of the IVE approach include: Mauro (1995), which uses ethnolinguistic fragmentation as a instrument for corruption; Hall and Jones (1999), which uses latitude as an instrument for European influence; and Acemoglu, Johnson and Robinson (2001), which uses settler mortality from the 19th century as an instrument for institutional strength via the importation of European institutions. On the other side, the detractors of the IVE method (as well as IVE practitioners amongst themselves) argue that each of these instruments is not valid because it either fails the exclusion restriction or is a weak instrument ($\text{corr}(Z_i, X_i) \approx 0$). Easterly and Levine (1997) argue that ethnolinguistic fragmentation has a direct effect on economic policies that affect growth. Sachs and Warner (2001) and

McArthur and Sachs (2001) argue that geography affects growth directly through resource endowment and current disease environment.

Rather than getting involved in a debate on instrumental validity, this paper takes a different methodological approach to the question of growth and institutions. The IVE approach relies on rather strong theoretical assumptions that cannot be proven from the data. In the case of the exclusion restriction, correlation is never quite zero and researchers must make qualitative (and hence debatable) evaluations if small enough is good enough. In addition, it is likely that an instrument that satisfies the exclusion restriction will be a weak instrument.

3 Methodology

Another approach to an endogenous system of equations relies on relationships among the data rather than econometric theory. The endogenaity problem that the IVE approach tries to solve is that institutions are responsible for a whole set of economic and social indicators that are in turn thought to be responsible for institutional strength. Rather than trying to model a causal theory (which requires identification of cause and effect or chicken and egg), this paper recognizes that all of the chickens and eggs are related and tries to model that relationship through factor analysis.

From the psychometric literature, factor analysis was originally used to estimate intelligence. Researchers observe an individual's responses to a set of questions but would like to estimate the individual's underlying intelligence which cannot itself be directly observed. Intelligence is thus a *latent* variable which is the underlying causal variable behind the observed test scores.

We can apply a similar conceptual framework to domestic institutions. Institutions are responsible for a range of outcomes that are in turn correlated with institutional strength. An aggregate measure of institutional strength, however, is difficult to obtain: qualitative

researchers frequently rely on the "you know it when you see it" identification test. By thinking of domestic institutions as a latent variable, this paper attempts to provide an aggregate estimate for institutional strength that relies on neither the exclusion restriction of the instrumental variables approach nor an *a priori* weighting scheme (as when constructing an index of aggregate institutional strength from other indicators).

Factor analysis has two components: exploratory factor analysis, which seeks to determine the number of latent dimensions along which the latent factor varies; and confirmatory factor analysis, which calculates the percentage of variability that can be explained by the chosen number of factors.

3.1 Data

Most data are from the 2004 CIA World Factbook, which provides the most comprehensive series of current indicators for items like GDP; GDP growth rates; GDP per capita; composition of industry, agriculture, and services as a percentage of GDP; fertility rates; life expectancy; literacy rates; population; population growth rates; and proven oil reserves. Polity scores for 2003 are taken from the POLITY IV data set (Marshall and Jaggers (2003)). Corruption indices are from the 2002 Transparency International corruption perception surveys. (International (2002)) While much can be done to improve the quality and quantity of the data, I use these indicators as a rough approximation.

4 Findings

The first step is to determine the number of dimensions or factors that can explain variations in the latent variable. I contend that a slightly more complex approach will yield results more in line with an analytic understanding of political institutions. From the early literature on modernization (insert cites), we might conceptualize the two axes of variation as economic

modernization and democratization. Alternatively, drawing on the social capital literature, we might think of the two axes as the strength of formal (legal) institutions and informal (social) institutions.

4.1 One Factor or Two?

Although the latent variable may vary on an infinite number of dimensions, there are declining marginal benefits to fitting an increasing number of factors. The simplest approach is to estimate a univariate measure of institutional strength. The distribution of latent factor scores is plotted in Figure 1.

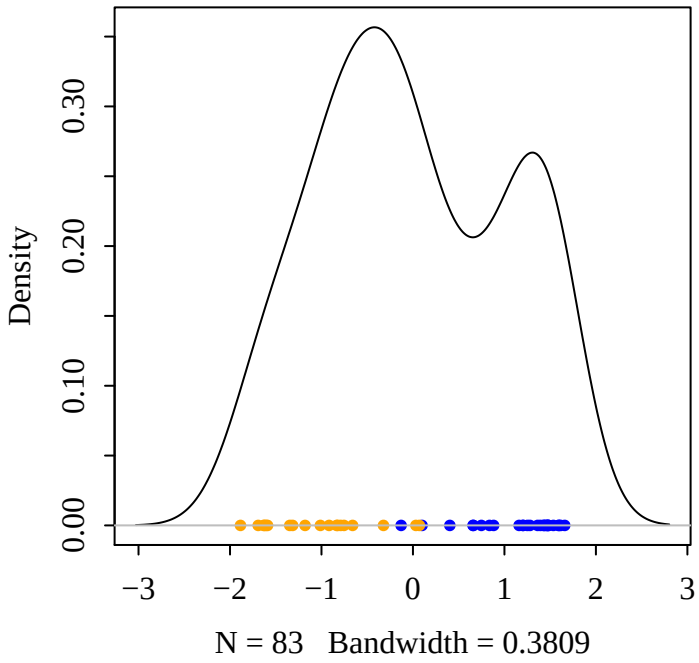

Figure 1: One-dimensional factor scores, including all variables. OECD countries are in blue, African countries are in orange. Assuming that OECD countries have strong institutions, I use the OECD latent scores to identify the distribution (weaker institutions to the left, stronger institutions to the right). Note that the left-most OECD country is Turkey and the right-most African country is South Africa.

Not surprisingly, the OECD countries are fairly tightly clustered at one end of the scale. Among OECD countries, the leftmost country is Turkey and the rightmost is Norway. The African countries are almost uniformly to the left of the OECD countries, with the exception of South Africa, which scores better than Turkey. Using a qualitative understanding of institutions in these anchor countries, I use these features to identify the distribution: values on the right end of the scale indicate stronger institutions while scores on the left end of the scale indicate weaker institutions.

Table 1: Top 10 and bottom 10 countries according to the univariate latent score

Top 10		Bottom 10	
Rank	Country	Rank	Country
1	Norway	74	Bangladesh
2	Denmark	75	Tanzania
3	Switzerland	76	Cameroon
4	United States	77	Malawi
5	Netherlands	78	Nigeria
6	Austria	79	Madagascar
7	United Kingdom	80	Ethiopia
8	Canada	81	Haiti
9	Finland	82	Angola
10	Sweden	83	Uganda

While a unidimensional latent factor seems to make sense based on the placement of OECD and African countries on the scale, and on the ranking of the top 10 and bottom 10 countries, the model does not explain as much of the variation as one would hope. Increasing the number of factors from one to two results in a substantial increase in the amount of cumulative variation explained by the model.

Table 2 shows that while the increase in explanatory power going from one to two factors *is* rather substantial (on the order of a 0.115 increase in the proportion of cumulative variation explained), the increase in explanatory power of going from two to three factors is smaller (on the order of a 0.048 increase in the proportion of cumulative variation explained).

The χ^2 statistic for the test that two factors is sufficient is 645 on 53 degrees of freedom, which corresponds to a p-value of 1×10^{-102}. Thus, the rest of this analysis will stick to a two-factor model.

Table 2: Cumulative variation explained by n factors (full specification)

Number of factors (n)	Cumulative variation explained by nth factor
1	0.463
2	0.578
3	0.626

However, estimating two factors rather than one factor makes the factor scores much more difficult to interpret. As Figure 2 shows, the OECD countries are now clustered in the upper right quadrant. The OECD countries closer to the origin (closer to the bottom left quadrant) have what we would qualitatively assess to be weaker institutions. As with the univariate measure, Turkey is among the weakest of the OECD country, with institutions "kind of like" those of South Africa. Denmark, a country which we qualitatively know to have strong institutions by any measure, scores closest to the upper right corner. The countries in the lower left quadrant include states that have undergone long periods of civil insurgency (Angola, Nigeria, Vietnam and Indonesia). The countries in the upper left quadrant are generally African states, but also include Pakistan and Guatemala.

Another strategy for identifying the two dimensions of variation are to look the outliers. Ireland, in the lower right quadrant, is a distinct outlier among the OECD group. The country closest to Ireland is Trinidad and Tobago, which is not really informative. Thus, looking to the axes of variation, the country most like Ireland in the first dimension is Singapore, and in the second dimension, Thailand or Indonesia.

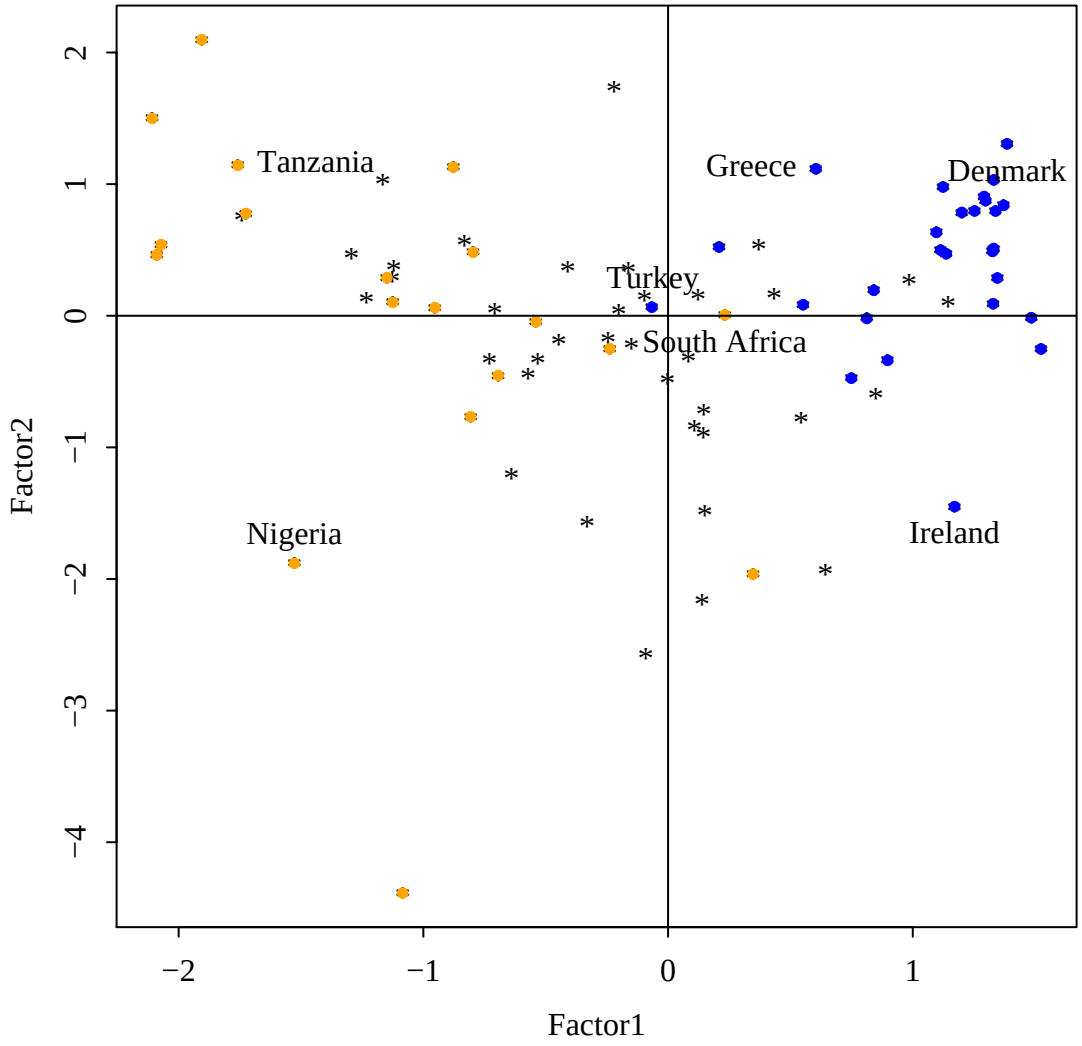

Figure 2: Two-dimensional factor scores, including all variables. OECD countries are in blue, African countries are in orange. Assuming that OECD countries have strong institutions, I use the OECD latent scores to identify the distribution (stronger institution along both dimensions of variation lie in the upper right quadrant). Note that South Africa exhibits institutional strength that is on par with some of the institutionally weaker OECD countries (such as Mexico and Turkey). Ireland in the lower right quadrant is a distinct outlier among OECD countries.

4.2 What are Factor 1 and Factor 2?

As mentioned before, the two sets of axes that the literature suggest include (formal institutions = rule of law, informal institutions = social capital) or (democracy, modernization). Of the two options, I think (very tentatively) that the (modernization, democracy) pair is most persuasive, based on the locations of Ireland and Turkey.

All of the OECD countries are pretty much democracies and score well on the x-axis. This includes Ireland which is well to the left of on the Factor 1 scale. We also know that among the OECD countries, Turkey has a legacy of military independence, and hence probably the weakest democratic institutions.

The second dimension (the y-axis) is much more difficult to identify as the modernization dimension. Ireland is certainly the most traditional or clannish of OECD countries, and the countries in the lower left quadrant are certainly traditional societies, but so are some of the ones in the upper left quadrant (such as Pakistan).

The ill identification of these two dimensions may result from the specification of the model. The results are as follows

These results indicate that two variables may be confounding the factor identification. The factor loadings for agriculture and industry move in opposite directions for Factor 1 and Factor 2, possibly because the sectors are not consistently defined across countries. Agriculture can include both subsistence farming and plantation (export) agriculture, which have different implications for institutional strength.[1]

Since there are substantial theoretical arguments that variables should have factors with

[1]The existence of plantation agriculture might promote weaker institutions for two reasons:

- Plantation agriculture implies a small number of powerful actors that control the majority of financial resources in a state, which in turn imply high income inequality, decreased growth, and weak social institutions.
- Plantation agriculture implies that Europeans did not settle in those regions (since European settlers normally demand European institutions), and hence, implies weak political institutions. (Acemoglu, Johnson and Robinson (2002))

Table 3: Results from the two factor model, full specification

		Loadings	
	Uniqueness	Factor 1	Factor 2
Expropriation risk	0.24	0.87	
Total literacy	0.42	0.76	
Life expectancy	0.50	0.70	0.11
Fertility	0.31	-0.83	
Population growth rate	0.50	-0.70	
GDP per capita	0.21	0.86	0.21
Polity IV score	0.65	0.55	0.21
Population	0.95		-0.23
Agriculture as a % of GDP	0.22	-0.86	0.17
Services as a % of GDP	0.23	0.69	0.54
Industry as a % of GDP	0.00	0.24	-0.97
GDP growth rate	0.95	-0.19	-0.13
Corruption index	0.31	0.81	0.19

loadings of the same sign (in other words, something that increases the degree of democracy also increases the degree of modernization, or something that increases the degree of formal institutional strength also increases the degree informal institutional strength), I discard the variables that relate to sectoral composition of the economy and reconsider the two factor model.

5 Alternative Specifications and Robustness Checks

The revised factor scores for a two factor model appear in Figure 3. The OECD countries are no longer strictly restricted to the upper right quadrant, but generally fall on the right side of the plot. The OECD countries in the lower right quadrant include Poland, the Czech Republic, Turkey, and Mexico. Other countries in this quadrant include other countries that are considered middle-income, such as Brazil, Argentina, and China. China, significantly, is the lowest country in the lower right quadrant; this suggests that the x-axis might represent

modernization and the y-axis might represent democracy. Fitting with this hypothesis, the United States is one of the countries highest in the upper right quadrant.

Unfortunately, the countries in the right half of the plot do not conform to these classifications. Madagascar, for example, is a relatively poor country in which kin ties still count for a lot, which would fit with the left side of the x-axis representing more traditional societies. Madagascar, however, does not confirm the hypothesis that the higher on the y-axis represents more democratic state institutions, since it's not really what most scholars consider a democracy.

As Figure 4 shows, these effects are robust to an expanded specification that includes services as a percentage of GDP. (In other words, the location of the latent scores do not change much for either Factor 1 or Factor 2.)

The final specification includes proven oil reserves in millions of barrels to proxy what Sachs and Warner (2001) refer to as the "curse of natural resources". This variable is orthogonal to both factors (both loadings were less than 0.1 in absolute value) and provides factor scores substantially the same as those in Figures 3 and 4.

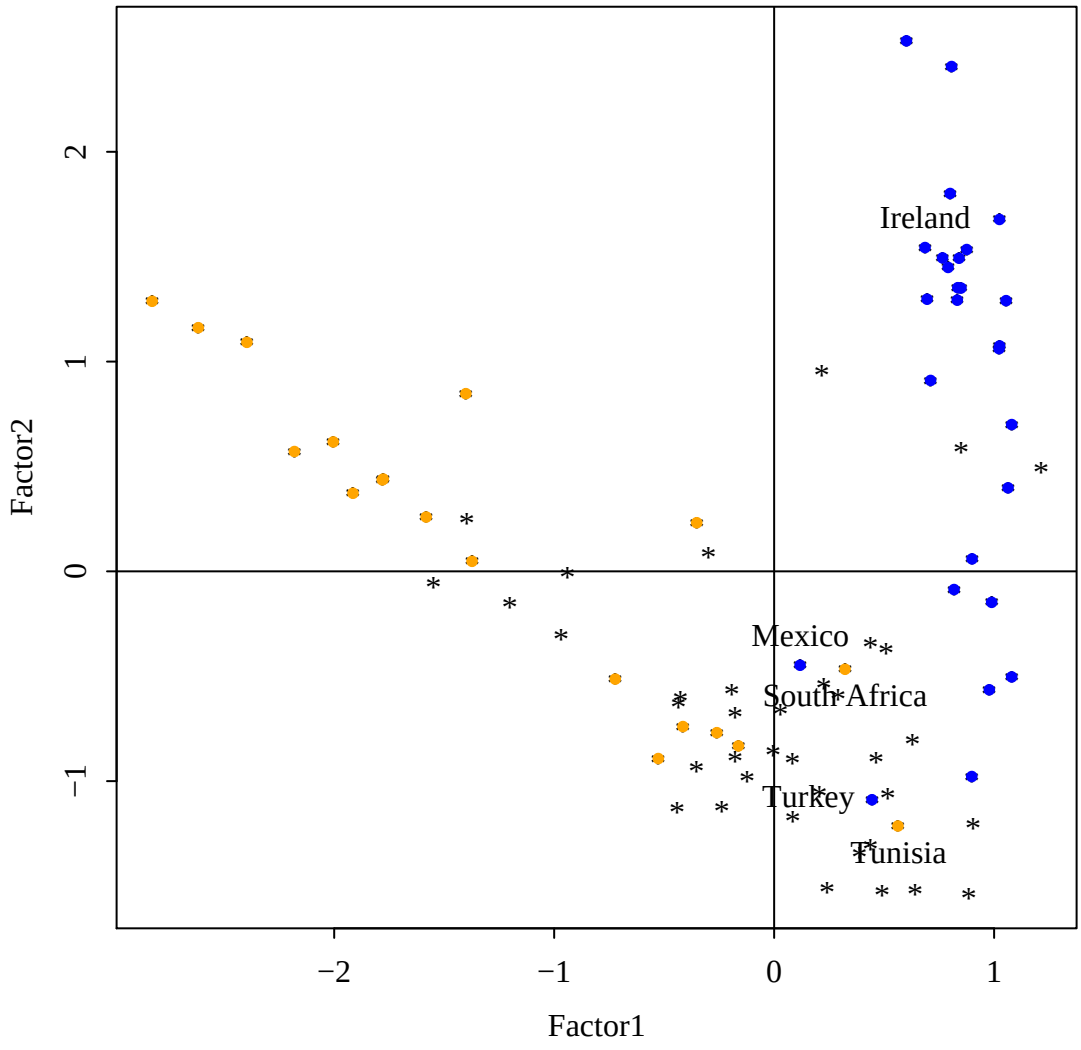

Figure 3: Two-dimensional factor scores, *excluding* industry, agriculture, and services as a percentage of GDP. OECD countries are in blue, African countries are in orange. The three non-OECD countries in the upper left quadrant are Israel, Taiwan, and Singapore. Mexico and South Africa have comparable institutional strength; as do Turkey and Tunisia. Other countries in the lower right quadrant include Poland, Brazil, Argentina, China, and other large middle income states.

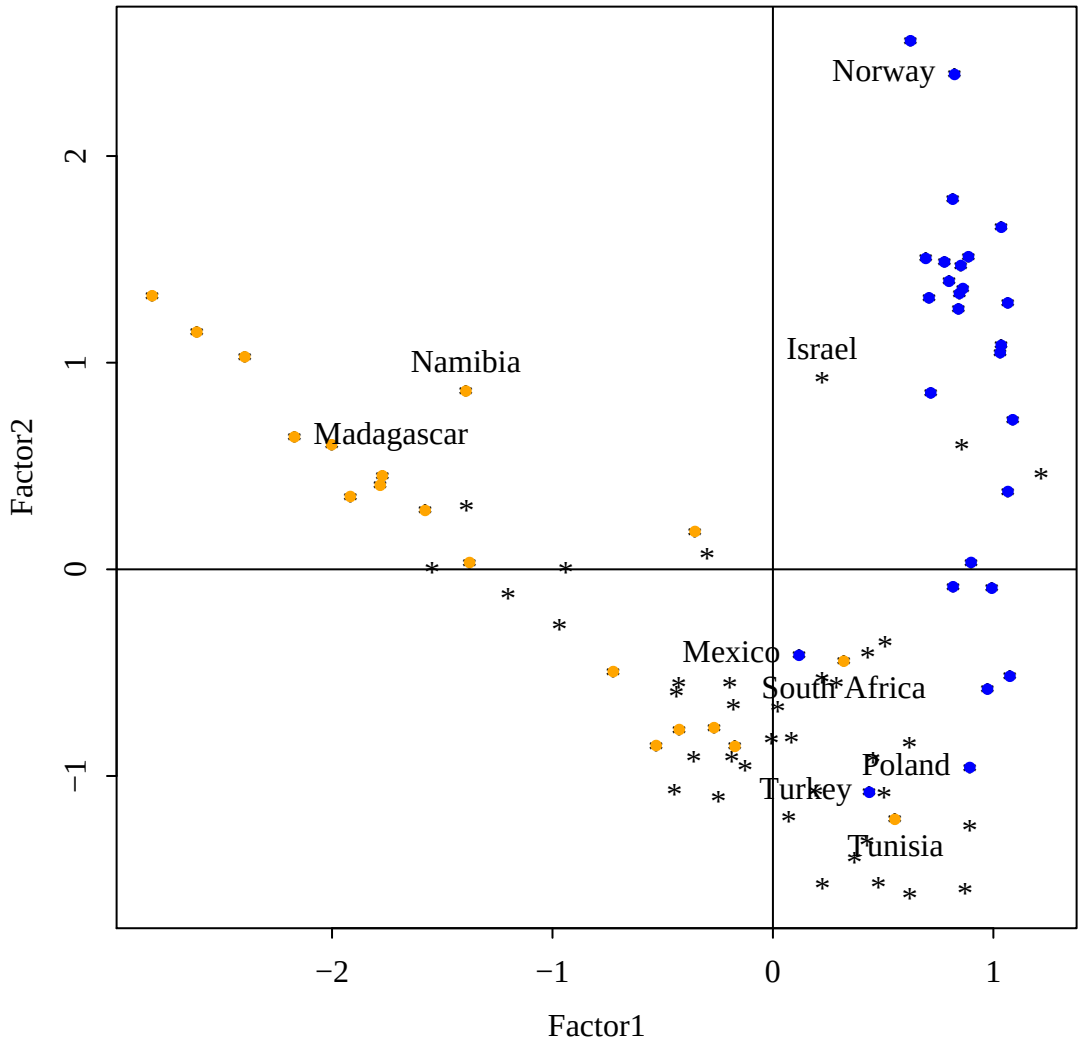

Figure 4: Two-dimensional factor scores, *including* services as a percentage of GDP. OECD countries are in blue, African countries are in orange. This plot is remarkably similar to Figure 3 (no sectors).

6 Conclusions and future research

Factor analysis and other latent variable models represent institutional strength without relying on complex assumptions to sustain hysteresis. Rather than becoming embroiled in debates over instrumental validity, this paper focuses on the available data to discern patterns among indicators that result from strong institutions.

One puzzling feature of the factor analysis approach is that it generally explains relationships among OECD countries and middle-income states, but works much less well for African states and other states that we normally consider institutionally and economically underdeveloped. In particular, countries do not lie on a diagonal running from the top right corner to the lower left corner. This would conform to a recognizable pattern: when things go well, everything goes well (which is what we observe with respect to most of the OECD countries), but when things do not go well, everything goes poorly. In fact, there is substantial variation among less developed countries in both latent factors, which suggest that identification of these two latent factors would go far toward classifying domestic political institutions.

I propose to take several steps to improve this measure of institutional strength:

1. The primary problem with this analysis is that the two latent factors cannot be easily defined from the data. Better data may improve these results, since the CIA Factbook is not the most accurate or comprehensive source for measures of institutional outcomes. Hence, the next step is to collect better outcome variables which will better reflect any underlying latent variables.

2. Another problem with the factor analysis approach generally is that we cannot incorporate qualitative prior information into the model to help identify the two latent factors. A Bayesian formulation, possibly using an item-response model, could better incorporate this information.

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