INSTITUTIONAL INFRASTRUCTURE AND ECONOMIC PERFORMANCE: LEVELS VERSUS CATCHING UP AND FRONTIER SHIFTS[*]

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Abstract:

We analyze the relationship between institutional infrastructure (capturing political stability, quality of government and social infrastructure) and overall country productivity for a sample of 57 (OECD and non-OECD) countries. Specifically, we compare empirical results for alternative productivity measures: output per worker and total factor productivity (TFP); in addition, we consider both levels and changes, where we decompose TFP changes into efficiency changes and technical changes. This gives us insight into the different channels through which the institutional infrastructure impacts on overall productivity performance: the 'accumulation' of production factors versus the 'accommodation' of production factors, and the 'shifting' of the world productivity frontier versus the 'catching up' with this frontier. In line with the existing literature, our results suggest a substantial accumulation effect: good institutions enhance capital accumulation. In addition, we find significant evidence in favor of an accommodation effect (in terms of both levels and changes), which elicits institutional quality as a 'lubricant' of the economic system: good institutions facilitate complex transactions, specialization and flexibility while reducing transaction costs. Interestingly, we find that good institutions enhance technical change as well as efficiency change.

Conveniently, the decomposition of TFP change also allows us to interpret the convergence issue, for which largely inconclusive evidence is obtained on the basis of a combined TFP measure. Our findings reveal that efficiency change is associated with convergence, i.e., countries with lower initial productivity realize higher productivity growth through catching up. By contrast, technical change corresponds to divergence, i.e., countries with higher initial productivity succeed in higher productivity growth through shifts of the technological frontier. One possible rationalization is that greater experience with technological innovation (i.e., a closer situation to the world technology frontier) benefits the implementation of new products and processes (i.e., the cost of additional innovations falls).

Keywords: institutions; productivity measurement; convergence
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1. INTRODUCTION

Why can some countries show a prominent and persistent track-record of economic prosperity while others can not or to a lesser extent? Standard growth theory identifies the accumulation of physical capital, investment in human capital and (endogenous) technological progress as driving forces behind aggregate production. But then the question remains: why do some countries invest more in skills and equipment than others? Or, given the accumulated stock of human and physical capital, why do some countries succeed in a more efficient use of the existing factors of production, thus raising productivity? Recent research investigates the 'deep determinants' of output growth, such as institutions, international trade and geography. In a stimulating paper, Rodrik et al. (2002) claim that the quality of institutions 'trumps' everything else. The title of their paper is outspoken and challenging: "Institutions rule: the primacy of institutions over geography and integration in economic development". Sachs (2001) and Gallup et al. (1998) question the primacy of institutions and favor geography. Recent research in the camp of international trade includes Frankel and Romer (1999); see Baldwin (2003) for a survey of this empirical literature. Acemoglu et al. (2001) provide an interesting contribution linking actual institutions to earlier colonial regimes, which in turn are shaped by geography (tropical diseases).

In this paper we focus on the role of institutions. The study of the impact of institutional arrangements on economic performance goes to the very heart of political economy, and has again become topical in the economic literature since the seminal paper of Barro (1991). Since then, an important strand of literature has moved into the direction of the institutional features of countries. A multitude of quality indicators for institutional infrastructure has been under empirical investigation. See, among many others, Mauro (1995), Knack and Keefer (1995, 1997), Easterly and Levine (1997), Hall and Jones (1999), Knack and Zak (2001) and Olsson and Hibbs (2002). Broadly defined, the institutional infrastructure of a country refers to the set of arrangements that shape the 'rules of the game' and the incentives for the economic agents. Clearly, private individuals and firms figure as agents but also as public servants and politicians. These incentives can encourage productive activities such as the accumulation of skills, investments in physical capital and also the development of product- and process-innovations. On the other hand, the institutional setting may give leeway to predatory behavior (theft, rent-seeking, corruption, …) which Hall and Jones (1999) label as 'diversion'. A favorable institutional infrastructure rewards productive efforts and suppresses diversion. This requires a clear definition of property rights, maintenance of law and order, a correct civil service, absence of corruption, political stability, …

A starting point for our analysis is provided by the recent work of Easterly and Levine (2001), who review different studies on the causes of growth. Basically, these authors find that factor accumulation alone does not suffice as an explanation for observed growth patterns. Rather, they indicate differences in total factor productivity (TFP, which relates total output to total labor and capital input) as the main reason for variation in output growth. Their general conclusion is that the examination of variation in TFP, i.e. the variation in prosperity that cannot be assigned to differences in labor and capital input, constitutes a most rewarding avenue for further research.

We empirically investigate the impact of the institutional infrastructure on TFP outcomes. But, deviating from the mainstream literature, our focus is not so much on the institutional indicators that we use, but on the measures employed for capturing TFP. Interestingly, and as we will explain in greater detail below, our TFP measures allow us to disentangle two 'channels' through which institutions can impact on total factor productivity, viz.:

- The '*factor accumulation*' effect; i.e., the fact that good institutions enhance factor accumulation. For example, we can reasonably expect that a favorable institutional infrastructure will foster investments in human capital and increase the stock of physical capital both from investments at home and from abroad.
- The '*factor accommodation*' effect; this refers to the role of institutions as the 'lubricant' of the economic system. Good institutions can be expected to improve the efficient use of the available stock of the production factors (capital and labor). Loosely put, good institutions 'grease the wheels' of the economic system. They accommodate economic exchanges with 'saving' in terms of transaction costs and diversion. Good institutions facilitate complex transactions, specialization and flexibility while reducing transaction costs in the sense of the costs of the economic system. This is especially apparent

in the literature on (asymmetric) information, incentives and contracts, which explicitly recognizes the role of institutions as setting the 'rules of the game'.[1] The functioning of good institutions in terms of reducing transaction costs and diversion also shows from their interpretation as a society's 'social capital', a concept that has become popular, also in economics, since the influential publications of Putnam (1993) and Fukuyama (1995).[2]

The aforementioned empirical studies have commonly focused on the combined accumulation and accommodation effects of the institutional infrastructure. This is most obvious for studies that relate GDP growth to institutions; the sole attention for output increase ignores the institutional impact in terms of input augmentation. But the same applies for studies that concentrate on GDP per worker ratios. By considering only the labor input, this measure partially captures overall TFP, and the associated institutional effect incorporates not only the factor accommodation channel but also the fact that good institutions augment investments (i.e., the factor accumulation channel). Indeed, the accumulation effect can be expected to work primarily through capital stock enlargement.

Our analysis ambitions to isolate the factor accommodation effect. To single out this effect, we use a TFP measure that takes into account both the capital stock and the labor stock. In other words, the accumulation effect is already captured in the TFP measure itself. The measure was first proposed by Färe et al. (1994). It compares each country to a (non-parametrically constructed) 'world productivity frontier'. The distance from that frontier then provides a proxy for the (relative) productivity level of each country within a particular year. Intertemporal changes of this frontier-distance represent (relative) productivity change. Interestingly, this approach allows us to decompose overall productivity growth into 'efficiency change' and 'technical change'.[3] The efficiency change component indicates how much closer a country gets to the

[1] For example, Hargreaves (1994) points out the growing appreciation that many economic interactions take the form of the three classic games (prisonner's dilemma, coordination and chicken), and that the institutional environment often affects the outcomes of these games.
[2] For example, the World Bank defines social capital as "the institutions, relationships and norms that shape the quality and quantity of a society's social interactions" (see http://www.worldbank.org/poverty/scapital/whatsc.htm). This definition directly relates social capital to the factor accommodation effect discussed in this study.
[3] In his review paper, Hulten (2000; p. 25) stresses this as an important advantage of the approach followed here.

world frontier over time (i.e., 'catching up'), while the technical change component indicates productivity growth due to world frontier (technological) shifts (i.e., 'innovation').

Our empirical analysis covers TFP changes (overall change, catching up and technical change) as well as TFP levels. Some authors (e.g., Hall and Jones (1999)) argue that the focus on TFP levels is more appropriate for studying the impact of the institutional infrastructure (e.g., claiming that levels better capture differences in long-run economic performance). We deliberately abstract from that discussion, and we consider both levels and changes in our empirical analysis. In both cases, we compare the results for our TFP measure with those for the more conventional GDP per worker ratio. From our above argument we expect that this will suggest a stronger effect of good institutions on GDP per worker than on TFP. Our empirical findings should thus indicate whether there is evidence for an accommodation effect in addition to the accumulation effect. Also, they should give us insight into the relative importance of both effects: in the first case the relation adds the accommodation effect to the accumulation effect, while in the second case only the accommodation effect is at play. Finally, given our specific TFP change measure, we can isolate the importance of the institutional infrastructure for respectively catching up and technological change.

Along the way, this approach allows us to check empirically (cross-country) convergence for the two components of TFP change (technical change and catching up). As it stands now, convergence theories and empirical evidence provide confusing conclusions; see, e.g., Temple (1999) and de la Fuente (2002) for recent reviews of the literature. It appears that different patterns emerge: some rich countries succeed in permanent growth while others rather stagnate, whereas some poor countries do catch up while others further deteriorate. Intuitively, in terms of our TFP change decomposition we can expect two mechanisms at play. Firstly, a higher initial TFP implies lesser capacity for catching up; i.e., the more productive country is situated closer to the world frontier, the less productive country can benefit from technological diffusion. Secondly, a higher initial TFP may well entail higher capacity for innovation as the return on R&D investments is an increasing function of scientific experience with innovative activities. The combination of this 'convergence' (through catching up) and 'divergence' (through innovation) effect can explain the existing inconclusive evidence. Our TFP change decomposition in catching up and frontier shifts allows for investigating that explanation (while controlling for the quality of the institutional framework).

In the next section, we briefly review the adopted approach to measuring TFP (levels and changes). Section 3 presents our empirical results. Section 4, finally, summarizes and provides some further discussion of our results.

2. Measuring productivity: a non-parametric approach

Productivity essentially pertains to the transformation of total input into total output. The rate of transformation represents the productivity *level*; productivity *change* indicates variation in the productivity levels over time. Our following exposition focuses on two consecutive years, which we denote as year 0 and year 1. Specifically, we discuss measures for the productivity level in both years and measures for the productivity change between both years; and we follow Färe et al. (1994) in decomposing productivity change into 'catching up' (or efficiency change) and 'technical change' (or innovation-driven change). We will assume perfect information about technology and prices when introducing the measures. In a further step, we turn to approximating the 'true' productivity value when such perfect information is not available, as is typically the case in practical applications (including our own; see Section 3).

We use the following notation: T^k represents the (closed and non-empty) production possibility set as defined by the technology in the year *k* (*k* = 0,1); y^k stands for the output vector and x^k for the input vector in *k*, the (non-negative) input-output quantity vector is $\left(x^k, y^k\right)$; p^k and w^k are the corresponding (relative) output and input price vectors, the (non-negative) input-output price vector is $\left(w^k, p^k\right)$. In our empirical application, y^k is the aggregate GDP level (i.e., y^k is a scalar), and the TFP input vector x^k contains the capital stock and the labor stock.

2.1 Productivity levels

We first consider the productivity level in each year *k* (*k* = 0,1). Using the price and quantity information, it is defined as[4]

[4] See Diewert and Nakamura (2002, 2003) for extensive reviews of productivity measures.

(1) $TFP^k = \dfrac{p^k y^k}{w^k x^k}$.

This measure divides output value by input value and can be interpreted as 'return-to-the-dollar' (see, e.g., Georgescu-Roegen (1951, p. 103)).[5]

In the following we will focus on 'relative' productivity levels or 'efficiency' levels, which are computed as the ratio of the actual ('absolute') TFP level as defined in (1) over the maximally attainable TFP level for given prices and technology in *k*, i.e.

(2) $RTFP_k^k = \left(\dfrac{p^k y^k}{w^k x^k}\right) / \left(\max\limits_{(x,y)\in T^k} \dfrac{p^k y}{w^k x}\right)$.

Clearly, for $\left(x^k, y^k\right) \in T^k$ we have $\left(\dfrac{p^k y^k}{w^k x^k}\right) \leq \left(\max\limits_{(x,y)\in T^k} \dfrac{p^k y}{w^k x}\right)$ or $RTFP_{T^k}^k \leq 1$; $RTFP_{T^k}^k = 1$ indicates that $\left(\dfrac{p^k y^k}{w^k x^k}\right) = \left(\max\limits_{(x,y)\in T^k} \dfrac{p^k y}{w^k x}\right)$, i.e., the maximum TFP level is effectively attained and the input-output combination $\left(x^k, y^k\right)$ is 'efficient' with respect to the possibility set T^k. Generally, the value of $RTFP_k^k$ captures the relative 'distance' of $\left(x^k, y^k\right)$ from the technological productivity frontier associated with T^k, where this distance is evaluated by using the prices $\left(w^k, p^k\right)$.

In our next discussion of productivity changes, we will also use relative productivity levels as defined with respect to technology and prices in *j* (*j* = 0,1; *j* ≠ *k*). Analogously as before, we define

(3) $RTFP_j^k = \left(\dfrac{p^j y^k}{w^j x^k}\right) / \left(\max\limits_{(x,y)\in T^j} \dfrac{p^j y}{w^j x}\right)$.

Obviously, since $\left(x^k, y^k\right)$ does not necessarily belong to T^j, the relative measure $RTFP_j^k$ need not be bounded by unity.

2.2 PRODUCTIVITY CHANGES

Productivity change measures capture variation in the productivity level between 0 and 1. In the following we will use the Fischer type TFP change measure (see, e.g., Diewert and Nakamura (2002, 2003) for discussion)

$$(4) \qquad TFPC = \left(\frac{\left(\frac{p^0 y^1}{w^0 x^1} \right)}{\left(\frac{p^0 y^0}{w^0 x^0} \right)} \right)^{1/2} \left(\frac{\left(\frac{p^1 y^1}{p^1 y^1} \right)}{\left(\frac{p^1 y^0}{p^1 y^0} \right)} \right)^{1/2} .$$

Avoiding an arbitrary base of comparison, this measure is computed as the geometric mean of the productivity ratios that are evaluated at the prices in year 0 and the prices in year 1. The interpretation is as follows: $TFPC > 1$ ($TFPC < 1$; $TFPC = 1$) indicates productivity growth (productivity decrease; constant productivity).

The decomposition of *TPFC* into catching up and technical change is obtained by noting that (using (3))

$$(5) \qquad TFPC = \frac{\left(\frac{p^0 y^1}{w^0 x^1} \right)^{1/2} \left(\frac{p^1 y^1}{p^1 y^1} \right)^{1/2}}{\left(\frac{p^0 y^0}{w^0 x^0} \right)^{1/2} \left(\frac{p^1 y^0}{p^1 y^0} \right)^{1/2}}$$

[5] Productivity as defined in (1) is sometimes also referred to as “profitability” (e.g., Balk (2002)).

$$
= \frac{\left(\left(\frac{p^0y^1}{w^0x^1}\right)/\left(\max_{(y,x)\in T^o}\frac{p^0y}{w^0x}\right)\right)^{1/2}\left(\left(\frac{p^1y^1}{w^1x^1}\right)/\left(\max_{(y,x)\in T^1}\frac{p^1y}{w^1x}\right)\right)^{1/2}}{\left(\left(\frac{p^0y^0}{w^0x^0}\right)/\left(\max_{(y,x)\in T^o}\frac{p^0y}{w^0x}\right)\right)^{1/2}\left(\left(\frac{p^1y^0}{p^1y^0}\right)/\left(\max_{(y,x)\in T^1}\frac{p^1y}{w^1x}\right)\right)^{1/2}}
$$

$$
= \frac{\left(RTFP_0^1\right)^{1/2}\left(RTFP_1^1\right)^{1/2}}{\left(RTFP_0^0\right)^{1/2}\left(RTFP_1^0\right)^{1/2}}
$$

$$
= \underbrace{\frac{RTFP_1^1}{RTFP_0^0}}_{catching\ up}\ \underbrace{\frac{\left(RTFP_0^1\ RTFP_0^0\right)^{1/2}}{\left(RTFP_1^1\ RTFP_1^0\right)^{1/2}}}_{technical\ change}.
$$

We derive two components of *TFPC*. The first component captures that TFP change can be the result of changes in the distance from the productivity frontier between 0 and 1. This is evaluated as the proportion of $RTFP_1^1$ over $RTFP_0^0$, which is a measure for *efficiency change* or *catching up* with the maximum attainable TFP level (defined by the technological productivity frontier) between 0 and 1. The second component indicates that TFP growth can also be due to shifts in the technology frontier between 0 and 1 (i.e., because of technological *innovation*). The concomitant measure for *technical change* is calculated as the geometric mean of the ratios of $RTFP_0^k$ over $RTFP_1^k$ (for *k*=0,1).[6]

Obviously, both catching up and technical change components can take values above and below unity. Note that both components may be moving in opposite directions. For example, TFP growth may occur because of innovation (i.e., the technical change value is above unity) while relative efficiency deteriorates (i.e., the catching up value is below unity), or vice versa. The above decomposition of TFP change is intuitive as both efficiency change and technical change have a clear impact on the perception of overall TFP change.

[6] The ratio of $RTFP_0^k$ over $RTFP_1^k$ (*k*=0,1) specifically captures technical change insofar as it affects the value of the relative productivity measure that we employ (see (2)).

2.3 COMPUTATIONAL ASPECTS

The computation of (relative) TFP levels and changes (overall change, catching up and technical change) boils down to computing $RTFP_j^k$ (*j,k*=0,1); see (2) and (5). This is relatively easy when the possibility sets T^k and prices $\left(w^k, p^k\right)$ are known (*k*=0,1). In our below application, however, we do not have such information and, hence, we should approximate $RTFP_j^k$ by $\widehat{RTFP}_j^k$ (*j,k*=0,1) on the basis of estimated possibility sets $\widehat{T}^k$ and prices $\left(\widehat{w}^k, \widehat{p}^k\right)$ (*k*=0,1).

We proceed as follows. First, the non-parametric approach (e.g., Varian (1984)) suggests to use the observed set of input-output vectors as $\widehat{T}^k$ (*k*=0,1). In our application, each such observation corresponds to a different country, so that the estimated technological frontier in fact represents the 'world productivity frontier'. In the following, we assume that there are *n* observed (country) input-output vectors in year 0 and 1; i.e., $\widehat{T}^k = \left\{\left(x_1^k, y_1^k\right),\ldots,\left(x_n^k, y_n^k\right)\right\}$ (*k*=0,1). Second, we use 'implicit' or 'shadow' prices for $\left(\widehat{w}^k, \widehat{p}^k\right)$ (*k*=0,1); i.e., for each country we select those prices that maximize $\widehat{RTFP}_j^k$ (*j,k*=0,1) (or: that 'minimize' the estimated relative distance of $\left(x^k, y^k\right)$ from the productivity frontier in *j*). Starting from (3), this gives the following programming problem for computing the value $\widehat{RTFP}_j^k$ associated with $\left(x^k, y^k\right)$ (*j,k*=0,1)

$$\text{(6)} \qquad \widehat{RTFP}_j^k = \max_{\left(\widehat{w}^j, \widehat{p}^j\right) \geq 0} \left[\left(\frac{\widehat{p}^j y^k}{\widehat{w}^j x^k} \right) \Big/ \left(\max_{(x,y) \in \widehat{T}^j} \frac{\widehat{p}^j y}{\widehat{w}^j x} \right) \right].$$

Using that only the relative input and output prices matter for the outcome of this problem, we can equivalently formulate it as

(7) $$\widehat{RTFP}_j^k = \max_{\left(\hat{w}^j, \hat{p}^j\right) \geq 0} \left[\hat{p}^j y^k \middle| \hat{w}^j x^k = 1; \max_{\left(x_i^j, y_i^j\right) \in \hat{T}^j} \frac{\hat{p}^j y_i^j}{\hat{w}^j x_i^j} \leq 1 \right],$$

which can be expressed in linear programming form as[7]

(8) $$\widehat{RTFP}_j^k = \max_{\hat{p}^k, \hat{w}^k} \hat{p}^j y^k$$

s.t.:

$$\begin{aligned}
&\hat{w}^j x^k = 1 \\
&\hat{p}^j y_i^j - \hat{w}^j x_i^j \leq 0 \quad \forall \left(x_i^j, y_i^j\right) \in \hat{T}^j = \left\{\left(x_1^j, y_1^j\right), \ldots, \left(x_n^j, y_n^j\right)\right\} \\
&\hat{p}^j \geq 0 \\
&\hat{w}^j \geq 0
\end{aligned}$$

Hence, the estimation of $RTFP_k^k$ (k=0,1) and *TFPC* (including its two components) boils down to solving four such linear programming problems (i.e., for the different combinations j,k=0,1). This should be repeated for the n countries under consideration, for every two consecutive years of the period under study.

Two final notes apply with respect to the practical computation of $\widehat{RTFP}_j^k$. First, the dual of the above programming problem expresses $\widehat{RTFP}_j^k$ as the Shephard (1970) input distance function associated with $\left(x^k, y^k\right)$, computed with respect to the convex conical hull of the set $\hat{T}^j$ (i.e., the production possibility set construct obtained directly from $\hat{T}^j$ by assuming constant-returns-to-scale and input and output free disposability); see, e.g., Charnes et al. (1978), who build on Farrell (1957).[8] This in turns enables to

[7] Compare with Charnes et al. (1978), who address a formally similar transformation of a fractional programming problem into a linear programming problem.
[8] See Färe et al. (1994) and Cooper et al. (2000) for more recent, general expositions of the nonparametric approach to productivity measurement (respectively within an economics and a management science orientation).

establish the relationship between the Fischer type productivity measurement (adopted here) and the Malmquist approach to productivity measurement (see Caves, Christensen and Diewert (1982 a,b); after Malmquist (1953)). See Färe and Grosskopf (1992).

A final point of attention concerns the fact that we use shadow pricing for approximating the true input and output prices. The result is that $\widehat{RTFP}_j^k$ imperfectly approximates $RTFP_j^k$ (even when abstracting from the fact that we approximate T^k by $\hat{T}^k$), which also impacts on the consequent estimate of *TFPC*. Still, resorting to general properties of the Shephard distance functions (which are dual to the $\widehat{RTFP}_j^k$; see above), Balk (1993) argues that the productivity change estimates based on shadow pricing form a reasonable approximation for the true values. See also Kuosmanen and Post (2000), who adapt Balk's argument to the specific *TFPC* measure in (4).

3. EMPIRICAL RESULTS

3.1 PRODUCTIVITY LEVELS AND PRODUCTIVITY CHANGES

Our input and output data are taken from the Penn World Tables (Mark 5.6; see Summers and Heston (1991)). We calculate productivity measures for a sample of 57 countries, which consists of 26 OECD countries and 31 non-OECD countries, and we consider the years 1975 (i.e., the year after the oil crisis hit) to 1990.[9] The two inputs are total employment and capital stock and the output is real GDP. Table A1 contains for each country the average productivity values (levels and changes) for the period 1975-1990 and Table A2 the country-specific productivity levels for the initial year 1975.[10]

A summary of the TFP results is given in Table 1. The table also includes results for the more conventional (level and growth) productivity measures, which refer to the GDP per worker ratios. Apart from a mere inspection of the summary statistics for the sample as a whole, it seems interesting to compare the computed productivity results for the OECD subsample with those for the non-OECD subsample; see also our concluding discussion in Section 4. For that reason, we include the OECD and non-OECD summary statistics in Table 1.

[9] Our sample of countries is determined by the criterion that consistent data were available in the Penn World Tables as well as for our institutional infrastructure indicators from other sources.

[10] In Table A1, the fact that Sierra Leona attains a TFP level value of unity may seem peculiar. Kumar and Russell (2002), who obtain a similar result from a similar sample, provide two (complementary) interpretations. (Kumar and Russell use the Shephard distance function rather than the relative measure in (8) for capturing productivity; as explained in section 2.3, the two approaches are dual to each other.) Their so-called 'literal' interpretation is that Sierra Leone, one of the poorest countries in the sample, is so poor particularly because it is so much undercapitalized. The other interpretation is that the method used for constructing the TFP measures (that directly builds on the observed set of countries) fails to fully recover the 'true' world technology especially for lower capital/labor ratios such as that of Sierra Leone. Still, in our core analysis (in Section 3.4), which deals with the determinants of productivity differences, we focus on central tendencies in the computed productivity values. This can be expected to 'average out' the impact of this kind of 'estimation error' effects (e.g., other poorly capitalized countries like Madagascar, Malawi and Sri Lanka attain very low TFP values). When the focus were on the productivity of individual countries, it would be recommendable to complement the computation of country-specific productivity values with statistical inference analysis (see, e.g., Simar and Wilson (2000) for a state-of-the-art survey of the tools that could be used, and Simar and Wilson (1999) for an application to the kind of productivity measures used in this study).

We find -not very surprisingly- that OECD countries are generally characterized by higher productivity levels. Still, the difference is much less pronounced for the TFP measure (0.774 versus 0.553) than for the GDP per worker ratio measure (23135 versus 7996; 1985 US dollars). The reason is that non-OECD countries are typically associated with relatively low capital/labor ratios in comparison to OECD countries. Therefore it is recommended to take both input dimensions into account when comparing overall productivity levels. This is exactly what the TFP level measure does, while the GDP per worker ratio solely relates labor stock to the overall output level.

If we then consider productivity changes, we observe that average productivity growth over the period 1975-1990 was only slightly positive: 0.3% according to the TFP measure; 1.1% according to the GDP per worker ratio. Next, we find that average growth was higher in OECD countries than in non-OECD countries: 0.9% versus –0.2% for the TFP measure; 1.9% versus 0.5% for the GDP per worker ratio.

As discussed in the previous section, the TFP measure can be further decomposed into changes *towards* the technological frontier ('efficiency change' or 'catching up'), and changes *of* the technological frontier ('technical change'). We find that the productivity growth of non-OECD countries is mostly realized through catching up with the production frontier (on average 0.9%), while the average impact of technical change turns out to be even negative (- 1.1%). The interpretation is that, in contrast to OECD countries (with average efficiency and technical change respectively 0.6% and 0.4%), the specific input allocation of the non-OECD countries in our sample has (on average) a negative effect on overall productivity change, due to *regress* of the associated technology frontier. This observation is directly related to our earlier remark that non-OECD countries are typically characterized by high labor and low capital stocks: we can expect a higher capital/labor ratio to be associated with a higher degree of technological innovation.[11]

Generally, these results suggest a diverging productivity pattern for OECD countries and non-OECD countries. Our following discussion specifically focuses on explaining these differences. Our discussion

[11] The results in Kumar and Russell (2002) support this argument.

concentrates mainly on institutional effects. In addition, we account for possible convergence/divergence issues in our analysis of productivity changes.

Table 1: Productivity level and productivity change (1975-1990); summary statistics

		TFP change	catching up	technical change	GDP per worker; change	TFP level	GDP per Worker; level ('85 US prices)
All	average	1.003	1.008	0.996	1.011	0.654	14901.296
	st.dev.	0.015	0.016	0.012	0.021	0.219	9614.208
	min.	0.973	0.975	0.973	0.965	0.225	1145.259
	max.	1.049	1.056	1.015	1.065	1.000	33220.451
OECD	average	1.009	1.006	1.004	1.019	0.774	23134.737
	st.dev.	0.008	0.012	0.011	0.013	0.129	6406.591
	min.	0.995	0.986	0.977	0.997	0.495	8755.343
	max.	1.024	1.046	1.015	1.065	1.000	33220.451
Non-OECD	average	0.998	1.009	0.989	1.005	0.553	7995.829
	st.dev.	0.018	0.019	0.008	0.024	0.229	5505.633
	min.	0.973	0.975	0.973	0.965	0.225	1145.259
	max.	1.049	1.056	1.004	1.060	1.000	21620.984

3.2 *COMPOSITE AND SYNTHETIC INSTITUTIONAL INDICATORS*

Our analysis focuses on three dimensions of institutional quality, viz. *political stability*, *quality of government* and *social infrastructure*. To focus our following regression analysis, we represent each dimension by a *composite* indicator, i.e. a combination of single indicators:

1. *Political stability* indicators, including political changes (CONSTCH and POWLOSS), political violence (COUPS, RIOTS) and war activity (WAR and WARCIV).
2. *Quality of government* indicators, including black market (BLCK), corruption (CORRUPTI, CORRUPTM) and law and order (RULELAW).
3. *Social infrastructure* indicators, including civil liberties (AGOVDEM, DEMOC and PURGES).

All data for the single indicators are taken from the Easterly and Levine (1997) data set,[12] which are further explained in Table 2.

[12] See http://www.worldbank.org/research/growth/ddeale.htm for sources and definitions.

Table 2: Institutional data

Category	Code	Number of observations	Description
1. Political Stability			
	CONSTCHG	53	Major Constitutional Changes (decade 1980-1989): The number of basic alternations in a state's constitutional structure, the extreme case being the adoption of a new constitution that significantly alters the prerogatives of the various branches of government.
	COUPS	53	'Coups d'Etat' (decade 1980-1989): The number of extra constitutional or forced changes in the top government elite and/or its effective control of the nation's power structure in a given year. Unsuccessful coups are not counted.
	POWLOSS	51	Power losses (decade 1980-1989)
	RIOTS	52	Riots (decade 1980-1989): Any violent demonstration or clash of more than 100 citizens involving the use of physical force.
	WAR	57	Dummy for war on national territory (decade 1980-1989).
	WARCIV	57	Dummy for civil war (decade 1980-1989).
2. Quality of Government			
	BLCK	57	Black Market Premium: Log of 1+ black market premium, average (decade 1980-1989).
	CORRUPTI (*)	56	Knack and Keefer measure of corruption (1980-89).
	CORRUPTM (*)	44	Mauro measure of corruption (1980-83).
	RULELAW	52	Rule of Law: Law and order tradition (decade 1980-1989).
3. Social capital			
	AGOVDEM	52	Anti-government demonstrations (decade 1980-1989): Any peaceful public gathering of at least 100 people for the primary purpose of displaying or voicing their opposition to government policies or authority, excluding demonstrations of a distinctly anti-foreign nature.
	DEMOC (**)	54	Measure of democracy; measured as a subjective measure of political freedom (Gastil's Political Rights; decade 1980-1989).
	PURGES	52	Purges (decade 1980-1989): Any systematic elimination by jailing or execution of political opposition within the ranks of the regime or the opposition.

Notes: (*): Higher values indicate less corruption; (**): lower values indicate a higher degree of democracy.

The three composite institutional quality indicators are then constructed in two steps. In a first step, we make the values of the different single indicators commensurable. That is, we normalize each indicator on a scale from 0 to 1, where higher values can be interpreted as an indication of higher-quality institutions. Specifically, for quality indicators where higher values reflect better quality (i.e., *indicator* = CORRUPTI, CORRUPTM, RULELAW), for each country *i* the normalized value is computed as

$$(19)\qquad indicator_i^n = \frac{indicator_i - indicator_{\min}}{indicator_{\max} - indicator_{\min}},$$

where subscript 'min' refers to the lowest indicator value over all countries that are under study and subscript 'max' to the highest indicator value; superscript 'n' indicates the normalized status of the indicator.

Similarly, when higher values indicate worse performance (i.e., *indicator* ≠ CORRUPTI, CORRUPTM, RULELAW), the normalized quality indicator is computed as[13]

(20) $$indicator_i^n = \frac{indicator_{\max} - indicator_i}{indicator_{\max} - indicator_{\min}}.$$

In a second step, we calculate composite indicators of political stability, government quality and social infrastructure as the arithmetic average of the respective single indicators.[14] Apart from a composite indicator for each country, we also construct an overall measure for *institutional infrastructure* as the arithmetic average of the three composite indicators. For ease of exposition we will label this overall measure as a *synthetic* indicator. The country values of the synthetic indicator are included in Table A3 in the appendix.

It can be argued that a well-defined synthetic indicator should adequately reflect the information captured by each of its components; a synthetic indicator should give a 'balanced' indication of the 'aggregate' performance in the different dimensions that are captured. Our synthetic indicator indeed correlates strongly with each of its three components: the associated correlation coefficient amounts to 0.816, 0.878 and 0.727 for the three composite indicators (respectively indicating political stability, government quality and social infrastructure).[15]

[13] Observe that we consider AGOVDEM as a 'bad'; it captures the extent to which government policy does not account for the different tendencies in the public opinion. Of course, as it comprises *peaceful* demonstrations it could also be interpreted a 'good'. Still, we believe its interpretation as institutional bad counterweights its interpretation as an institutional good; the second interpretation would be more appropriate if the measure were expressed as a proportion of all (peaceful and violent) demonstrations.

[14] We are confronted with missing data for a number of single indicators. In such cases, we compute a composite indicator by taking the arithmetic average of those (normalized) single indicators for which data are available for the evaluated country.

[15] On a similar basis, we can conclude that the three composite indicators do well reflect the information captured by each of their components (i.e. basic single indicators): for all but one single indicator the correlation coefficient is above 0.5; in most cases, it is above 0.75. (The one correlation coefficient that is below 0.5 is that between POWLOSS and the composite quality of government indicator, which amounts to 0.369.)

3.3 *Regression analysis*

In our following regressions, we hypothesize a structural model that is formally similar to that of Hall and Jones (1999). An attractive feature of that model is that it is parsimonious; it only includes the institutional infrastructure to explain differences in productivity performance. Using instrumental variables, we account for the possible problem of 'reverse causality'; i.e., while it can reasonably be expected that institutions affect the productivity performance, it can also be argued that productivity impacts on institutional quality.

We first consider the model for productivity levels. Let *ProdMea* represent the productivity level measure (GDP per worker level or TFP level) and *InstInd* the institutional indicator (institutional infrastructure, political stability, quality of government or social infrastructure). We get the following structural model:

(21) $$\text{ProdMea} = \alpha + \beta \ \text{InstInd} + \gamma$$

and

(22) $$\text{InstInd} = \delta + \varepsilon \ \text{ProdMea} + \varsigma X + \eta ,$$

where X comprises three instrumental variables: ethnolinguistic fractionalization, a dummy for Sub-Saharan Africa and a dummy for Latin America and the Caribbean. Again, these variables are taken from Easterly and Levine (1997).[16]

In the case where *ProdMea* stands for a productivity change measure (GDP per worker change, TFP change, technical change or catching up) we additionally control for the initial productivity level (respectively GDP per worker or TFP level in 1975; see Table A2) in our regressions. Conveniently, this allows us to check the convergence hypothesis not only for the overall TFP measure but also for its technical and efficiency change components. For example, as discussed in the introduction, it could well be that efficiency change is associated with convergence (countries with lower initial productivity realize

[16] Our measure for ethnolinguistic fractionalization is AVELF in the Easterly and Levine dataset.

higher productivity growth through catching up) while technical change corresponds to divergence (countries with higher initial productivity realize higher productivity growth through innovation).

Our results are presented in Tables 3, 4 and 5.[17] To keep our discussion focused, we restrict our comparison to the coefficients of the alternative institutional indicators and the determination coefficients associated with the different regressions. In our regressions for productivity change (see Tables 4 and 5) we also include the coefficient values associated with the initial productivity levels.

Recall that we expect a stronger relationship for the GDP per worker measures than for the TFP measures. The results in Table 3 confirm this *a priori* hypothesis: for all four institutional indicators the coefficient and R^2 values associated with the GDP per worker level are (often considerably) higher than those corresponding to the TFP level measure. This finding reflects the fact that in the regression with the TFP level only the accommodation effect plays, whereas in the GDP per worker regressions also the accumulation effect shows up on top of the accommodation effect. It is interesting to note that we find convincing evidence for the existence of an accommodation effect: the coefficient associated with the institutional variables is everywhere significantly different from zero for the TFP level measure.

Interestingly, we find a similar pattern for productivity changes: institutional quality impacts on productivity change to a greater extent when the latter is measured as the change of the GDP per worker ratio. Again, this is evidenced by the size of the coefficient values as well as the R^2; see Table 4. This means that also for productivity changes there appears to be some 'superadditionality' of the accommodation and the accumulation channel running from institutional quality.

The results in that table also allow us to check the convergence hypothesis, which in the standard case predicts a negative sign of the estimated coefficient for the initial productivity level. In only 4 out of the 8

[17] We divided the GDP per worker ratio of each country by the maximum value in the sample (i.e., associated with the US) so as to obtain (relative) productivity values between 0 and 1; compare with (3) in section 2.1. This also yields that the coefficients of the different institutional indicators for our GDP per worker (level) regressions are more directly comparable to those for the TFP (level) regressions.

regressions the negative coefficient differs significantly from zero (at the 10% level). In one case it is significantly positive (i.e., where we use social infrastructure as the institutional indicator), which itself suggests divergence rather than convergence. These findings lead us to mixed conclusions; seemingly, our results for the overall productivity change measures rather weakly support convergence.

Table 3: Institutional infrastructure and levels of productivity

Dependent variable	**GDP per worker level (average, 1975-1990)**				**Total factor productivity level (average, 1975-1990)**			
Institutional infrastructure	1.567				0.659			
	(0.233)				(0.221)			
p-value	0.000				0.000			
Political stability		2.527				0.953		
		(0.477)				(0.424)		
p-value		0.000				0.000		
Quality of government			0.970				0.402	
			(0.152)				(0.142)	
p-value			0.000				0.000	
Social infrastructure				3.804				1.448
				(0.734)				(0.056)
p-value				0.000				0.000
R^2	0.451	0.338	0.425	0.341	0.140	0.084	0.128	0.086
# Observations	57	57	57	54	57	57	57	54
Instrumental variables	Ethnolinguistic fractionalization, a dummy for Africa and a dummy for Latin America and the Caribbean							

Notes: Each column contains the regression results for the institutional indicator in the corresponding row; standard errors of the estimated coefficients are between brackets; "p-value" stands for the probability that the coefficient equals zero under normality.

Table 4: Institutional infrastructure and productivity changes

Dependent variable	**GDP per worker change (average, 1975-1990)**				**Total factor productivity change (average, 1975-1990)**			
Initial productivity	-0.023	-0.015	-0.011	0.227	-0.014	-0.012	-0.015	-0.007
	(0.009)	(0.010)	(0.010)	(0.067)	(0.008)	(0.008)	(0.007)	(0.008)
p-value	0.021	0.135	0.270	0.001	0.073	0.150	0.043	0.329
Institutional infrastructure	0.148				0.084			
	(0.028)				(0.018)			
p-value	0.000				0.000			
Political stability		0.179				0.109		
		(0.043)				(0.028)		
p-value		0.000				0.000		
Quality of Government			0.083				0.047	
			(0.014)				(0.009)	
p-value			0.000				0.000	
Social infrastructure				0.227				0.119
				(0.067)				(0.041)
p-value				0.001				0.005
R^2	0.352	0.252	0.410	0.191	0.280	0.216	0.329	0.143
# Observations	57	57	57	54	57	57	57	54
Instrumental variables	Ethnolinguistic fractionalization, a dummy for Africa and a dummy for Latin America and the Caribbean							

Notes: Each column contains the regression results for the institutional indicator in the corresponding row; standard errors of the estimated coefficients are between brackets; "p-value" stands for the probability that the coefficient equals zero under normality.

A further decomposition of TFP changes in catching up and technical change may clarify this issue. Indeed, Table 5 suggests an unambiguous convergence-divergence pattern. Specifically, catching up leads to convergence in the sense that a lower initial TFP level endorses a higher degree of catching up; we obtain a significantly negative regression coefficient for initial productivity. One possible explanation is that the public good character of technological knowledge tends to favor less advanced countries, i.e., countries that are initially situated far from the technological frontier. By contrast, technological change leads to divergence. High initial TFP facilitates a higher degree of technological change or innovation-driven productivity progress; see the significantly positive regression coefficient. One potential rationalization is that a higher degree of experience with technological innovation (i.e., a closer situation to the technological productivity frontier) benefits the implementation of new products and processes (e.g., the cost of additional innovations falls). These results at least suggest that disentangling productivity change into catching-up and innovation components may provide a reasonable explanation for the mixed evidence regarding the convergence issue that is hitherto obtained.[18]

Table 5 also allows us to further anatomize the institutional accommodation effect, which is our main concern. Our findings show a positive relationship between institutional infrastructure and technical change; high quality institutional designs enhance the shifting of the frontier, as revealed by the significantly positive regression coefficient for the institutional variables. Apparently, product- and

[18] We note the difference between these findings and those obtained by Kumar and Russell (2002), who check the convergence-divergence pattern on a two-year basis (1965 and 1990), by relating the different productivity change measures to the initial GDP per worker level. In contrast to our findings, these authors locate convergence in terms of overall TFP change but not in terms of efficiency change, while equally obtaining divergence in terms of technical change; see their Figure 4. Note that our results in Table 5 are based on the initial TFP level rather than the GDP per worker level; it seems more natural to control for initial TFP given the focus of our study. Still, we obtain the same qualitative convergence-divergence conclusions on the basis of correlation tests (at 1%, 5% or 10% significance levels) where we relate overall TFP change, catching up and technical change to the 1975 GDP per worker level. (These results are not reported but can be reconstructed from the data in Tables A1 and A2.) We see at least two possible explanations for the difference between the Kumar and Russell findings and ours: (i) Kumar and Russell consider the period 1965-1990 while we consider the period 1975-1990 (i.e., after the oil crisis hit); (ii) the Kumar and Russell productivity results are obtained on a two-years basis while we use (geometric) average productivity change estimates over all years between 1975 and 1990 (in our opinion, the use of average values seems recommendable because of the sensitivity of the nonparametric productivity measures for extreme data values, which may be due to measurement errors). A more detailed investigation falls beyond the scope of this study but it may constitute an interesting avenue for follow-up research. Such investigation may also include a (counterfactual) distribution analysis similar to that of Kumar and Russell, to account for the criticism (most notably by Quah (e.g., 1997)) on the type of regression-based convergence-divergence analysis adopted here.

process-innovations blossom when private rewards are protected and market preservation institutions prevail. Interestingly, we find a similar positive effect for the efficiency change measure. (In this case, especially the political stability and the government quality seem to matter; social infrastructure is not significant at the 10% level.) Hence, the aforementioned catching up effect becomes even stronger in the case of a high-quality institutional environment.[19]

As a concluding exercise, we can be interested in the type of institutions that are particularly important to ensure high productivity. More specifically, is it a high-quality government, political stability or a well-developed social infrastructure that exhibits the 'most significant' relationship with our economic performance measures? We choose the determination coefficient as our base of comparison between the different composite indicators. The reason is that a direct comparison of coefficient values is difficult, since each composite indicator captures alternatively defined single indicators. Also, the R^2 values tell us to what extent productivity variation can be explained by variation in each institutional indicator, which seems to constitute an appropriate 'importance' criterion.

Interestingly, we discern a grossly similar pattern for each productivity measure (change or level): our quality of government indicator always turns out to be associated with the highest R^2 value, followed by political stability and social infrastructure, in that order. This finding indicates that, also from the point of view of economic prosperity, the importance of high quality government can hardly be denied. Good government institutions enhance the accumulation as well as the accommodation (both in terms of catching up and technical change) of the production factors.

[19] See Evans (2001) for an interesting discussion of the adequacy of 'institutional monocropping' for countries in the catching-up phase.

Table 5: Institutional infrastructure and catching up versus technical change

Dependent Variable	**Catching up (average, 1975-1990)**				**Technical change (average, 1975-1990)**			
Initial productivity	-0.041	-0.039	-0.042	-0.035	0.026	0.027	0.026	0.027
	(0.008)	(0.008)	(0.008)	(0.007)	(0.006)	(0.005)	(0.005)	(0.006)
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Institutional infrastructure	0.051				0.033			
	(0.019)				(0.013)			
p-value	0.008				0.015			
Political stability		0.063				0.047		
		(0.028)				(0.020)		
p-value		0.030				0.022		
Quality of Government			0.029				0.018	
			(0.009)				(0.007)	
p-value			0.003				0.010	
Social infrastructure				0.071				0.049
				(0.040)				(0.030)
p-value				0.084				0.116
R^2	0.353	0.325	0.373	0.313	0.415	0.408	0.423	0.386
# Observations	57	57	57	54	57	57	57	54
Instrumental variables	Ethnolinguistic fractionalization, a dummy for Africa and a dummy for Latin America and the Caribbean							

Notes: Each column contains the regression results for the institutional indicator in the corresponding row; standard errors of the estimated coefficients are between brackets; "p-value" stands for the probability that the coefficient equals zero under normality.

4. Summary and Concluding Discussion

We have analyzed the relationship between institutional infrastructure (political stability, quality of government, social infrastructure) and overall country productivity. Deviating from the existing literature, our analysis has concentrated on the explained variable (i.e., country productivity) rather than on the explaining variable (i.e., country institutions). Specifically, we have compared results for productivity measures that account only for the labor stock (i.e., output per worker ratios) with those for measures that incorporate both the labor stock and the capital stock (i.e., TFP measures). We have argued that an analysis based on the former type of measures includes both the accumulation and accommodation effect of the institutional infrastructure, whereas a TFP based analysis singles out the accommodation effect. Also, the study of convergence/divergence in terms of catching up and technical change separately may clarify –at least to some extent- the convergence debate.

Our empirical findings suggest a significant combined accumulation and accommodation effect, which falls in line with the existing literature. More interestingly, our evidence also supports a significant accommodation effect. In other words, better institutions do not only attract more investments, they also contribute to 'fine-tuning' the coordination of the available capital and labor stock (e.g., by facilitating economic transactions). This 'superadditionality' of the accumulation and the accommodation channel seems to hold for productivity levels as well as for productivity changes. A further decomposition of the institutional impact on productivity changes reveals that good institutions stimulate catching up as well as innovative activities. When looking at the effect of the different components of our overall institutional infrastructure measure (political stability, government quality and social infrastructure), we identify a particularly strong case for instituting a high-quality government, which is here quantified in terms of a low black market premium, a low degree of corruption and a well-established tradition of law and order. That is, variation in government quality explains for a considerable deal observed variation in productivity performance (in terms of TFP levels, TFP changes, efficiency changes as well as technical changes).

Our analysis mainly focused on the factor accommodation effect of good institutions; the factor (in particular capital) accumulation effect was treated as the difference between the overall effect (captured by the GDP per worker measures) and the accommodation effect (captured by the TFP measures). A more detailed investigation of this accumulation effect seems like a rewarding avenue for follow-up research. For example, we have related the generally higher technical change values for OECD-countries (as compared to non-OECD countries) to typically higher capital-labor ratios. This suggests investigating the determinants of the capital-intensity of an economy as a useful step towards a more complete understanding of overall productivity performance.

As an interesting by-product, our TFP construct allows us to investigate the convergence issue for the catching up and technical change components of TFP change. Attractively, our results suggest a particularly clear convergence-divergence pattern. First, catching up is characterized by convergence: a lower initial TFP level generally implies a higher degree of catching up; less productive countries have more possibility for getting closer to the world frontier, and may benefit more from technological diffusion. By contrast, technical change is associated with divergence: an initial situation that is closer to the world frontier in general implies a higher degree of innovation-driven productivity growth; innovation investments may have a greater pay-off for countries with more innovation experience, i.e. countries that are situated more closely to the world productivity frontier. In our opinion, this convergence-divergence pattern may provide a plausible explanation for the by and large mixed nature of the existing evidence on convergence phenomena across countries and regions; see also our own evidence for a combined productivity change measure (GDP per worker and overall TFP growth). Since the convergence-divergence issue does not constitute the core focus of the current study, we have refrained from a further in-depth investigation of these relationships (e.g., including a robustness analysis).[20] But at least our results indicate that such study may constitute a valuable avenue for follow-up research.

[20] Also, it is worth to stress that our results pertain to convergence-divergence in TFP and not in income (measured, e.g., by GDP per capita or GDP per worker). Kumar and Russell (2002) employ similarly constructed productivity measures to investigate convergence-divergence in terms of income differences. See also footnote 17, where we relate their results to ours.

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APPENDIX

Table A1: Productivity level and productivity change (1975-1990, averages); country values

	COUNTRY	TFP change	catching up	technical change	GDP per worker; change	TFP level	GDP per worker; level ('85 US prices)
OECD	AUSTRALIA	1.010	0.996	1.014	1.010	0.845	28074.516
	AUSTRIA	0.999	0.997	1.003	1.017	0.733	23488.933
	BELGIUM	1.016	1.003	1.014	1.016	0.831	27600.509
	CANADA	1.013	0.999	1.014	1.014	0.888	29519.588
	DENMARK	1.006	1.001	1.005	1.014	0.690	22677.584
	FINLAND	1.024	1.010	1.015	1.025	0.684	22802.575
	FRANCE	1.013	1.001	1.013	1.016	0.817	27056.149
	GERMANY WEST	1.016	1.001	1.015	1.016	0.810	26942.938
	GREECE	1.006	1.007	0.999	1.018	0.572	15729.547
	ICELAND	0.999	1.006	0.993	1.021	0.947	22627.232
	IRELAND	1.016	1.018	0.998	1.030	0.721	18889.610
	ITALY	1.011	1.010	1.001	1.026	0.842	26680.811
	JAPAN	1.010	1.010	1.000	1.036	0.571	17558.647
	KOREA REP.	1.021	1.046	0.977	1.065	0.495	9974.920
	LUXEMBOURG	1.024	1.008	1.015	1.024	0.913	30459.157
	MEXICO	1.003	1.002	1.000	1.002	0.752	16803.469
	NETHERLANDS	1.004	0.997	1.006	1.009	0.882	28869.732
	NEW ZEALAND	0.995	0.986	1.009	0.997	0.773	25447.474
	NORWAY	1.020	1.005	1.015	1.020	0.791	26341.043
	PORTUGAL	1.011	1.030	0.982	1.032	0.679	12027.449
	SPAIN	0.997	0.999	0.998	1.016	0.802	22123.037
	SWEDEN	1.008	0.995	1.014	1.009	0.778	25825.522
	SWITZERLAND	1.009	0.994	1.015	1.009	0.882	29310.741
	TURKEY	1.000	1.022	0.979	1.025	0.533	8755.343
	U.K.	1.008	1.010	0.998	1.020	0.898	22696.180
	U.S.A.	1.008	1.000	1.008	1.013	1.000	33220.451
non-OECD	ARGENTINA	0.984	0.991	0.992	0.988	0.772	15758.652
	BOLIVIA	0.996	1.019	0.977	0.999	0.404	6195.470
	CHILE	1.004	1.025	0.980	1.018	0.675	10448.392
	COLOMBIA	1.008	1.015	0.993	1.013	0.431	8691.272
	DOMINICAN REP.	0.976	0.991	0.985	0.998	0.619	7513.844
	ECUADOR	0.990	0.994	0.996	1.003	0.426	9917.131
	GUATEMALA	0.993	1.007	0.987	1.001	0.763	8204.176
	HONDURAS	1.005	1.025	0.980	1.004	0.412	4959.146
	HONG KONG	1.049	1.056	0.994	1.058	0.788	15937.888
	INDIA	1.021	1.022	0.999	1.030	0.337	2558.988
	ISRAEL	1.009	1.008	1.001	1.011	0.773	21620.984
	JAMAICA	0.993	1.015	0.978	0.977	0.475	5478.373
	KENYA	1.003	1.003	1.000	0.999	0.296	2055.021
	MADAGASCAR	0.984	0.990	0.994	0.984	0.225	1766.543
	MALAWI	1.002	1.019	0.984	1.007	0.269	1145.259
	MAURITIUS	1.007	1.016	0.991	1.027	0.887	8107.637
	MOROCCO	1.013	1.020	0.993	1.016	0.739	6498.021
	NIGERIA	0.978	0.975	1.004	0.975	0.468	3018.966
	PANAMA	0.994	0.994	0.999	0.995	0.386	9324.606
	PARAGUAY	0.996	1.000	0.996	1.016	1.000	6413.921
	PERU	0.973	0.986	0.988	0.972	0.499	8914.148
	PHILIPPINES	1.000	1.015	0.986	1.004	0.446	4736.452

SIERRA LEONE	0.973	1.000	0.973	0.990	1.000	2737.387
SRI LANKA	1.019	1.040	0.980	1.033	0.290	4244.973
SYRIA	0.992	0.998	0.994	1.005	0.723	16524.931
TAIWAN	1.026	1.033	0.992	1.060	0.489	12355.174
THAILAND	1.025	1.034	0.992	1.048	0.449	4698.631
VENEZUELA	0.977	0.977	1.000	0.979	0.780	20992.160
YUGOSLAVIA	0.976	0.993	0.983	1.002	0.783	11367.188
ZAMBIA	0.980	0.992	0.988	0.965	0.318	2696.270
ZIMBABWE	1.001	1.026	0.976	0.981	0.225	2989.101

Table A2: Productivity levels (1975); country values

	COUNTRY	*TFP level*	*GDP per worker; level ('85 US prices)*
OECD	AUSTRALIA	0.862	25988.876
	AUSTRIA	0.765	20638.826
	BELGIUM	0.825	24858.805
	CANADA	0.901	26746.930
	DENMARK	0.689	20250.716
	FINLAND	0.654	19697.669
	FRANCE	0.816	23817.254
	GERMANY WEST	0.775	23342.000
	GREECE	0.536	13531.925
	ICELAND	0.796	18345.850
	IRELAND	0.644	15469.522
	ITALY	0.767	21359.259
	JAPAN	0.530	13380.832
	KOREA REP.	0.312	6244.991
	LUXEMBOURG	0.885	26661.970
	MEXICO	0.710	16265.909
	NETHERLANDS	0.919	27420.618
	NEW ZEALAND	0.866	25970.864
	NORWAY	0.725	21851.026
	PORTUGAL	0.498	10354.547
	SPAIN	0.839	20723.037
	SWEDEN	0.830	24795.123
	SWITZERLAND	0.898	27073.681
	TURKEY	0.430	7586.928
	U.K.	0.814	19841.941
	U.S.A.	1.000	30133.100
non-OECD	ARGENTINA	0.737	16045.499
	BOLIVIA	0.315	5908.987
	CHILE	0.448	9185.760
	COLOMBIA	0.350	7697.611
	DOMINICAN REP.	0.582	7104.673
	ECUADOR	0.404	8896.291
	GUATEMALA	0.672	7644.129
	HONDURAS	0.290	4394.115
	HONG KONG	0.444	9729.864
	INDIA	0.296	2068.234
	ISRAEL	0.748	20237.391
	JAMAICA	0.405	7149.113
	KENYA	0.284	1944.481

MADAGASCAR	0.240	2009.053
MALAWI	0.251	1089.038
MAURITIUS	0.767	7001.018
MOROCCO	0.646	5550.105
NIGERIA	0.585	3065.607
PANAMA	0.362	8702.993
PARAGUAY	1.000	5070.521
PERU	0.490	10485.296
PHILIPPINES	0.370	4457.748
SIERRA LEONE	1.000	3007.219
SRI LANKA	0.175	3090.841
SYRIA	0.679	14802.777
TAIWAN	0.363	7727.582
THAILAND	0.345	3371.338
VENEZUELA	0.931	23760.142
YUGOSLAVIA	0.653	9704.000
ZAMBIA	0.336	3637.446
ZIMBABWE	0.159	3257.122

Table A3: Synthetic and composite indicators of institutional quality; country values

	synthetic	political stability	quality of government	social capital
ARGENTINA	0.681	0.777	0.546	0.722
AUSTRALIA	0.982	0.989	0.958	1.000
AUSTRIA	0.965	0.993	0.902	1.000
BELGIUM	0.934	0.830	0.972	1.000
BOLIVIA	0.538	0.779	0.236	0.600
CANADA	0.996	0.989	0.998	1.000
CHILE	0.698	0.613	0.758	0.722
COLOMBIA	0.671	0.603	0.465	0.944
DENMARK	0.990	0.993	0.976	1.000
DOMINICAN REPUBLIC	0.787	0.897	0.520	0.944
ECUADOR	0.816	0.947	0.558	0.944
FINLAND	0.975	0.996	0.983	0.944
FRANCE	0.988	0.993	0.970	1.000
GERMANY, WEST	0.959	0.993	0.924	
GREECE	0.846	0.986	0.608	0.944
GUATEMALA	0.569	0.609	0.321	0.778
HONDURAS	0.668	0.929	0.243	0.833
HONG KONG	0.926	0.950	0.901	
ICELAND	0.999	1.000	0.997	1.000
INDIA	0.530	0.447	0.531	0.611
IRELAND	0.961	0.982	0.901	1.000
ISRAEL	0.846	1.000	0.660	0.878
ITALY	0.899	0.986	0.766	0.944
JAMAICA	0.624	0.578	0.351	0.944
JAPAN	0.944	1.000	0.920	0.911
KENYA	0.728	0.957	0.448	0.778
KOREA, REPUBLIC OF	0.348	0.231	0.536	0.278
LUXEMBOURG	0.999	1.000	0.996	1.000
MADAGASCAR	0.790	0.954	0.693	0.722
MALAWI	0.703	0.947	0.439	0.722
MAURITIUS	0.951	0.965	0.945	0.944
MEXICO	0.790	0.968	0.512	0.889

MOROCCO	0.737	0.965	0.412	0.833
NETHERLANDS	0.999	1.000	0.998	1.000
NEW ZEALAND	0.992	0.979	0.998	1.000
NIGERIA	0.536	0.500	0.162	0.944
NORWAY	0.997	0.993	0.998	1.000
PANAMA	0.669	0.762	0.413	0.833
PARAGUAY	0.650	0.957	0.215	0.778
PERU	0.618	0.450	0.459	0.944
PHILIPPINES	0.523	0.613	0.328	0.628
PORTUGAL	0.903	0.975	0.789	0.944
SIERRA LEONE	0.637	0.887	0.246	0.778
SPAIN	0.887	0.970	0.779	0.911
SRI LANKA	0.696	0.617	0.526	0.944
SWEDEN	0.990	0.993	0.976	1.000
SWITZERLAND	0.992	0.977	0.998	1.000
SYRIAN ARAB REPUBLIC	0.366	0.371	0.049	0.678
TAIWAN, CHINA	0.715	1.000	0.813	0.333
THAILAND	0.775	0.975	0.461	0.889
TURKEY	0.520	0.223	0.558	0.778
UNITED KINGDOM	0.984	0.986	0.967	1.000
UNITED STATES	0.982	0.982	0.964	1.000
VENEZUELA	0.796	0.950	0.438	1.000
YUGOSLAVIA	0.769	1.000	0.538	
ZAMBIA	0.629	0.816	0.292	0.778
ZIMBABWE	0.594	0.443	0.450	0.889