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Alejandro Quijada

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Calidad institucional y productividad total de los factores en América Latina y el Caribe: explorando lo inobservable mediante análisis factorial

Alejandro Quijada*

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Centre d'Etudes et de Recherches sur le Développement International (CERDI), Université d'Auvergne, Clermont-Ferrand (France).

Correo electrónico: alejandro.quijada@u-clermont1.fr.

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Este documento determina hasta qué punto variaciones a corto plazo en la productividad total de los factores (PTF) en Latinoamérica, se ven influenciadas por cambios de calidad institucional. Primero, se emplean herramientas estadísticas provenientes del análisis factorial para extraer, de un grupo de indicadores observables, un conjunto de factores inobservables, los cuales se asocian con la PTF y con la calidad institucional; luego, se estima, empleando métodos panel, la relación entre la productividad agregada y los elementos subyacentes de la calidad institucional. Los resultados indican que las libertades económicas están relacionadas positivamente con la PTF.

Clasificación JEL: C33, O47, O54

Palabras clave: productividad total de los factores, análisis factorial, latinoamérica.

Institutional Quality and Total Factor Productivity in Latin America and the Caribbean: exploring the unobservable through factor analysis

Alejandro Quijada*

This document determines, for a sample of Latin American countries, to what extent short-term variations in total factor productivity (TFP) are influenced by changes in institutional quality. Our empirical strategy is two-folded. First, we use statistical tools borrowed from factor analysis to extract from observable outcome indicators, unobservable common factors associated to TFP and institutional quality. Second, panel estimations are performed, linking the latent elements of aggregate factor productivity to the underlying common factors of institutional quality. Results are appealing: economic liberty is positively related to short-term total factor productivity

JEL Classification: C33, O47, O54.

Keywords: institutions, total factor productivity, factor analysis, Latin America.

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Centre d'Etudes et de Recherches sur le Développement International (CERDI), Université d'Auvergne, Clermont-Ferrand (France).

E-mail: alejandro.quijada@u-clermont1.fr.

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I. INTRODUCTION

A major breakthrough in the area of macroeconomics was the unification of business cycle and growth theories by Kydland and Prescott (1982); accordingly, exogenous stochastic technological innovations —i. e. fluctuations in total factor productivity (TFP) or supply shocks— would explain most recurrent short-term output deviations in industrialized economies. Regarding the sources of fluctuations in developing countries, domestic shocks, particularly supply-side ones, have also been identified as the main explaining factors of aggregate economic volatility. In this sense, Hoffmaister and Roldós (1997) and Ahmed (2003), in the Latin American context and Arreaza and Dorta (2004), in the case of Venezuela, demonstrate through the estimation of structural vector autoregressions (SVAR) that supply innovations account for more than 50% of total output variations.

More recently a strand of the business cycle literature has concentrated on the endogenous causes of technological change, paying particular attention to the details of the innovation process, notably in terms of investment decisions in human capital and the adoption and diffusion of new technologies, via research and development (R&D) (Evans *et al*., 1998; Jones *et al*., 2003 and Comin and Gertler, 2006). A common denominator in these new modeling approaches is the underlying importance of institutions, —i. e. humanly devised formal and informal constraints (North, 1990)—, as a fundamental source of fluctuations, affecting aggregate productivity through the effectiveness or the efficiency of the resource allocation process they embody (e. g. investment in new technologies, given the existence of significant transaction costs). Put differently, even though institutions are deemed to evolve slowly over time, they play a crucial role in explaining output variations at business cycle frequencies, through their impact on the incentive structure of any given market-oriented economic environment: i. e. the context in which total factor productivity builds up. Consequently, good institutions may foster short and medium-term growth by favoring productivity-enhancing activities; conversely, it also seems reasonable to assume that bad institutions may deter growth at high frequencies by inducing severe resource misallocation.

It is important to point out that a feature characterizing the modern empirical analysis of institutions and their impact on economic growth (Hall and Jones, 1999; Acemoglu *et al*., 2001, 2003 and Rodrik *et al*., 2004) and aggregate factor productivity (Dawson, 1998 and Girma *et al*., 2003) has been the focus on long-term relationships. Are the short and long-term approaches compatible? The answer is probably affirmative. In the new growth literature, institutions, more specifically institutional quality can be viewed as the cumulative outcome (a stock variable) of policy actions (a flow variable), which by their nature are more flexible and prone to sudden changes (Rodrik *et al*., 2004); correspondingly, policies can also reflect the underlying level of institutional quality in a given environment (Acemoglu *et al*., 2003). Consequently, institutions may influence short-term growth through the policies (i.e. the resource allocation process) they induce.

An extreme example of the short to medium-term implications institutions may have on aggregate economic performance is illustrated by the case of Venezuela. In 1999 a new constitution was adopted via referendum, introducing considerable institutional changes in a variety of aspects of Venezuelan society, ranging from the creation of new civilian powers, the extension of the presidential mandate, to the inclusion of the military's right to vote (Vera, 2003). At the same time, most of the opposition parties considered that many of these transformations seriously undermined fundamental sociopolitical and economic liberties, by increasing discretionality and the concentration of power in the presidential figure (Balza, 2002). As political tensions between government and opposition rose, the country reached a political impasse in year 2002. After a general strike and a failed *coup d'État*, Venezuela plunged into one of its most severe economic recessions (2002-2003), even though oil prices were on a rising path; real GDP decreased around 16%, investment fell 56% and unemployment rose from 12.8% in 2001 to 16.8% in 2003. In this case, the adoption of a new constitution may be interpreted as a major change in the incentive structure of the Venezuelan economy, which translated into the implementation of a set of policies conducing to the socio-economic meltdown of 2002.

Another example of the impact institutions may have on economic activity at relatively high frequencies is illustrated by the case of the Argentinean crisis. In 1991 the convertibility plan was introduced, which involved among other market-oriented policies, fixing by law the exchange rate of the Peso to the US Dollar. After a fairly long period of sustained growth (1991-1998, excluding the Mexican crisis period of 1994-1995), the absence of sufficiently prudent fiscal policies and structural reforms, consistent with the adopted currency board foreign exchange system, resulted in the emergence of a severe economic and financial crisis by the end of year 2000 (IMF, 2004). Consequently, in 2002 GDP decreased by 11%, inflation attained 41% and unemployment rose to 20.4%. In fact, the convertibility plan can be seen as a set of policies that, given the underlying quality of Argentinean institutions, led to severe resource misallocation and the financial crisis.

Does this mean that institutions influence growth at business cycle frequencies? Of course other external factors, such as fluctuations in international markets or the Mexican and Brazilian crises, might also explain the contraction of Venezuelan and Argentinean productive activities; additionally and from a more general perspective, major institutional changes, as those implied by the adoption of a new constitution, are not recurrent in the short-term. Nevertheless, the evidence from Argentina and Venezuela suggests that in the presence of institutional weaknesses, decision makers may fail to make the right policy choices, a fact that has irrefutable short-term consequences.

The aim of this study is therefore to empirically assess the pertinence of institutional quality in explaining cyclic fluctuations in Latin America and the Caribbean, an area widely characterized by its significant economic and sociopolitical volatility. In this sense, given the importance of supply shocks in the region and the recent developments in the business cycle literature previously evoked, the focus will be on the relationship between total factor productivity and institutions. However, a major empirical concern is that both TFP and institutional quality are not directly observable; consequently, they should be treated as latent variables, only quantifiable through their effect on measurable indicators.

Our empirical strategy is two-folded. First, we make use of statistical tools borrowed from factor analysis in order to extract from observable outcome indicators, unobservable common factors associated to TFP and institutional quality. To this matter, three major unobserved institutional factors are identified: sociopolitical liberty, which is associated to political and civil rights; economic liberty, which basically corresponds to the soundness and the regulatory quality of economic policy; and financial liberty, a factor related to the depth of private sector intermediation in domestic financial markets. Second, panel estimations are carried out, linking the latent elements of aggregate factor productivity to the underlying common factors of institutional quality.

This work therefore extends the scope of Latin-America's empirical business cycle and growth literatures by providing alternative reliable measures of TFP and institutional quality and most importantly, by shedding light into the short to medium-term implications, institutions may have. In this sense, results are quite appealing: economic liberty appears to be positively and significantly related to short-term total factor productivity; put differently, good governance fosters growth at business cycle frequencies.

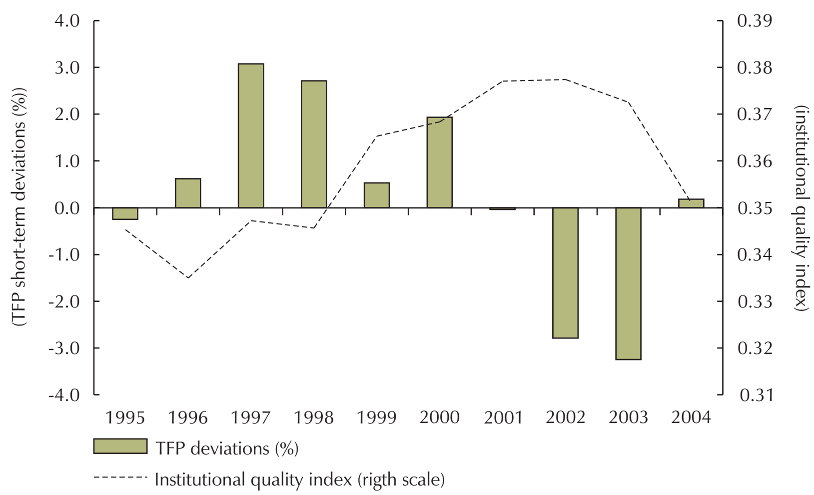
The rest of the paper is organized as follows; section II explores the empirical links in Latin America and the Caribbean and presents the main practical limitations generally encountered when measuring TFP and institutional quality. The standard exploratory factor analysis model is described and implemented in section III; section IV is devoted to the empirical assessment of the factor productivity-institutional quality relation. To conclude, some remarks are drawn in section V.

II. FLUCTUATIONS IN TOTAL FACTOR PRODUCTIVITY AND THE ROLE PLAYED BY INSTITUTIONS: EMPIRICAL LINKS, LIMITATIONS AND POSSIBLE SOLUTIONS

Latin American and Caribbean societies have experienced for the last ten years important economic and political changes that may have translated, through transformations in the underlying incentive structure of their economies, into major aggregate fluctuations (Santiso, 2006). In this sense, Graph 1 depicts the cyclic variations of total factor productivity and the evolution of institutional quality[1] in 21 Latin American and Caribbean economies.

1 Given our interest in short-term dynamics, we must rely on existing available annual data. In this sense, the Heritage Foundation's index of economic freedom represents, to our knowledge, the only freely available source, covering a sufficiently long period of time and a wide range of institutional dimensions.

Graph 1
Short-term TFP Shifts and Institutional Quality Evolution in Latin America and the Caribbean, 1995-2004

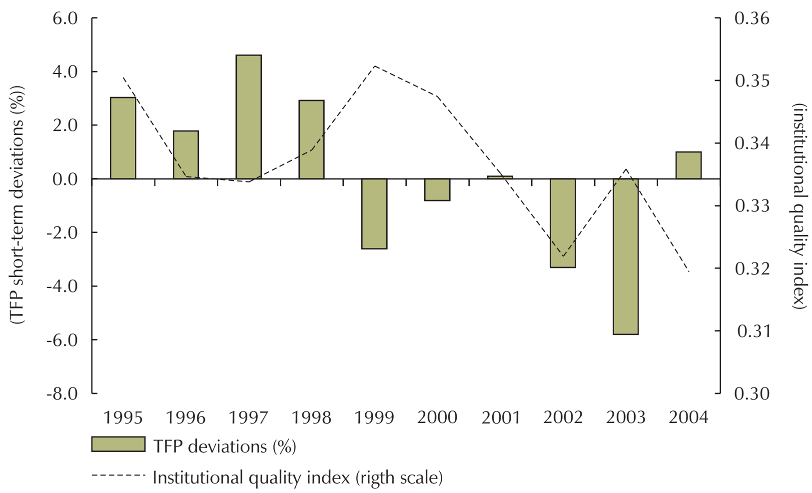


Note: Short-term TFP fluctuations are approximated by the cyclic component of the Solow Residual (see Appendices 1 and 2). The institutional quality index corresponds to the Heritage Foundation's index of economic freedom (see Appendix 1). The scale is inverted in order to facilitate comprehension: high values represent high institutional quality.
Both variables are weighted by country-specific real GDP at constant US$.
Source: Author's calculations.

First of all, we notice that the quality of institutions in the region constantly improved during the 1996-2000 period; second, throughout the same time span, short-term deviations in total factor productivity remained positive. Even more interesting is the fact that most decreases in institutional quality were associated to low TFP growth episodes or negative short-term deviations in aggregate productivity. At the sub-regional level, graphs 2 and 3 present the short-term evolution of TFP and institutional quality in the Andean Community of Nations (ACN) and the Common Market of the South (Mercosur).

In the Andean countries, the evolution of institutional quality has not followed a clear pattern (Graph 2); nevertheless, from 1999 to 2004 a deterioration of institutions was roughly observed, notably due to political instabilities in Ecuador, Peru and Venezuela, at the same time cyclic deviations in aggregate productivity have been either negative or barely positive. Additionally, institutional quality in year 2004 was considerably lower than it was in the mid 90's. Regarding Mercosur (Graph 3), we notice that institutional quality and short-term total factor productivity

Graph 2
Short-Term TFP Shifts and Institutional Quality Evolution in the ACN, 1995-2004



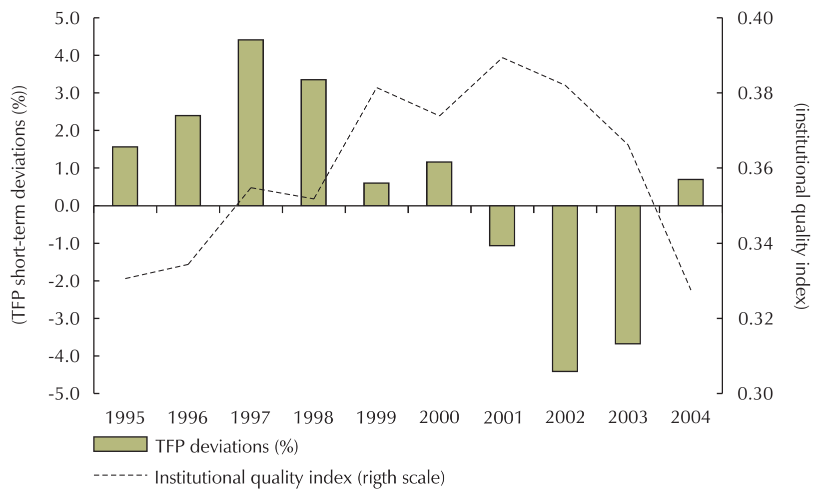
Note: The Andean Community is comprised of Bolivia Colombia, Ecuador, Peru and Venezuela
Short-term TFP fluctuations are approximated by the cyclic component of the Solow Residual (see Appendices 1 and 2). The institutional quality index corresponds to the Heritage Foundation's index of economic freedom (see Appendix 1). The scale is inverted in order to facilitate comprehension: high values represent high institutional quality. Both variables are weighted by country-specific real GDP at constant US$.
Source: Author's calculations.

evolved quite similarly during the period under consideration. From 1995 to 2001 we observe a positive tendency, followed by a sharp decline basically associated to the Argentinean crisis, attaining in 2004 an institutional quality score inferior to the one registered in 1995.

The empirical linkages between TFP and institutional quality in Latin America and the Caribbean are further analyzed by testing, form an econometric perspective, the robustness of the relationship. To this matter, Table 1 presents panel estimations of the cyclic component of aggregate productivity on our selected measure of institutional quality, using the aggregate index as well as its several components.

At a first glance, no important co-movement between institutions and the cyclic component of total factor productivity is found. In fact, the aggregate index of institutional quality is far from being significant; additionally, when incorporating the disaggregated constituents of the index, only monetary policy and banking appear to be statistically relevant. Nevertheless, these results are to be interpreted with caution,

Graph 3
Short-Term TFP Shifts and Institutional Quality Evolution in Mercosur, 1995-2004



Note: Mercosur is comprised of Argentina, Brazil, Paraguay and Uruguay.
Short-term TFP fluctuations are approximated by the cyclic component of the Solow Residual (see Appendices 1 and 2). The institutional quality index corresponds to the Heritage Foundation's index of economic freedom (see Appendix 1). The scale is inverted in order to facilitate comprehension: high values represent high institutional quality.
Both variables are weighted by country-specific real GDP at constant US$
Source: Author's calculations

in fact, the empirical assessment of the relationship under study entails a number of important issues.

First, the institutional indicator depicts an empirical simplification through aggregation, which could be misleading, since the aggregation process involves grouping socio-economic dimensions with different intrinsic characteristics, such as informal market and fiscal burden. In other words, the aggregate index may wrongly suggest the existence of complete homogeneity within the indicators that compose it, rendering the statistical (in)significance between TFP and institutions difficult to interpret.

Second, even if the outcome indicators are not completely homogeneous, they could be significantly correlated among them, therefore neutralizing or offsetting their impact on TFP.

Third, unobserved heterogeneity, at the regional and country-specific levels, may also influence both institutions and factor productivity; consequently, by not taking it into account, empirical results lose much of their significance.

Fourth and possibly most importantly, a major difficulty in empirically evaluating the impact of institutions on TFP lays on the way these two macroeconomic aggregates are defined and measured. In the first place, total factor productivity is usually calculated as a residual, defined as the fraction of output that cannot be explained

Table 1
OLS Estimation

Variable	TFP (1)	TFP (2)
Aggregate index	0.194	---------
	(0.63)	---------
Trade	---------	0.248
	---------	(1.00)
Fiscal burden	---------	0.039
	---------	(0.99)
Gov't intervention	---------	0.026
	---------	(1.47)
Monetary policy	---------	-0.046 ***
	---------	(-3.57)
Foreign investment	---------	-0.009
	---------	(-0.65)
Banking	---------	0.049 **
	---------	(2.54)
Wages & prices	---------	-0.183
	---------	(-1.00)
Property rights	---------	-0.194
	---------	(-0.79)
Regulation	---------	0.047
	---------	(1.20)
Informal market	---------	0.038
	---------	(0.86)
R-squared	0.002	0.102
Observations	210	210

Note: Dependent variable: Cyclic component of total factor productivity. t-statistics in parentheses. 10% significance is denoted by (*), 5% is denoted by (**) and 1% is denoted by (***).
Source: Author's calculations.

by changes in measurable productive factors, such as capital and labor.[2] Additionally, its computation relies on quite restrictive assumptions, ranging from ad-hoc production elasticities to Hicks-neutral technological change; regarding the latter hypothesis, standard growth accounting exercises suppose that technological innovation only affects TFP; nevertheless, it is to be expected that a productivity shift will also have an impact on capital accumulation through investment in enhanced technology; therefore, existing measures of factor productivity based on the Solow Residual formula can only partially account for actual TFP changes, which are essentially unobservable. Empirically, in the presence of measurement errors, differences in the quality of factors and changes in their relative intensities of production, total factor productivity may be seriously overestimated (Jorgenson and Griliches, 1967; Barro, 1998). To this matter, Bebczuk (2000) analyzes the sources of growth in 138 countries by the use of confirmatory factor analysis, a statistical technique designed to deal with unobservable or latent variables. Assuming the presence of unobserved technological innovations and the existence of two transmission channels (savings and productivity), the author manages to accurately estimate a standard growth model. Nonetheless, factor productivity remains unmeasured, even though its long-term transmission mechanisms are accounted for.

In relation to institutions, definition and measurement are even harder problems to deal with. In general terms, good institutions ensure two desirable outcomes (IMF, 2005): equal access to economic opportunity and protection in terms of property rights and remuneration to those providing production factors. In this sense, several indexes measuring different dimensions of institutional quality are currently available;[3] these indicators are based on a broad range of sources including interviews, surveys, ratings and national accounts. However, the information on institutional quality provided by these indexes remains very limited given the fact that they measure an outcome that might be explained not only by country-specific institutional factors, which in practice are not directly observable or measurable, but also by other non-institutional external elements such as climatic shocks or fluctuations in international markets. To this matter, Kaufmann *et al*. (2004) construct, using an extension of the standard unobserved components model, six aggregate governance indicators, based on several hundred variables from different sources; accordingly, each of the

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2 Deterministic and stochastic frontier analyses represent alternative solutions. These methods are however very demanding in terms of information. For an introduction see Coelli *et al*. (1998).

3 See Appendix 1, Table A1.3 for sources and definitions.

six groups or clusters is expressed as a linear function of the unobserved common component of governance; nevertheless, information on the underlying quality of institutions is still incomplete since the analysis is performed on variables measuring an outcome which partially reflects the true unobserved quality of institutions.

In general terms, the limitations to empirically quantify total factor productivity and institutional quality may be associated to an unobservable variable problem. In fact current institutional indexes and Solow Residual's approximations can be considered as partial measures or outcome indicators of the latent true institutional and productivity structures. In this sense, a convenient though far from perfect solution resides in the application of exploratory factor analysis, a multivariate statistical technique which aims at explaining the underlying and unobservable structure of a given number of observed variables.

III. MEASURING THE UNOBSERVABLE CHARACTERISTICS OF TFP AND INSTITUTIONAL QUALITY THROUGH EXPLORATORY FACTOR ANALYSIS

A. THE STANDARD MODEL

Exploratory factor analysis derives a set of latent dimensions, known as factors, which explain the measured variables, given the information on the interrelations among observed variables, (i. e. the correlation matrix); put differently, exploratory factor analysis expresses the observed variables in terms of, or as a function of unobserved common and specific factors.[4]

The standard model is defined as:

$$\begin{aligned} x_1 &= a_{11}f_1 + a_{12}f_2 + \ldots + a_{1k}f_k + u_1 \\ x_2 &= a_{21}f_1 + a_{22}f_2 + \ldots + a_{2k}f_k + u_2 \\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ x_p &= a_{p1}f_1 + a_{p2}f_2 + \ldots + a_{pk}f_k + u_p \end{aligned} \qquad (1)$$

4 Factor analysis has a long tradition in social and natural sciences, with applications to psychology, sociology, geology and medicine (Kline, 1994).

where $x_1, x_2, \ldots, x_p$ denote p observed and normalized variables; $f_1, f_2, \ldots, f_k$ represent k common factors ($k << p$); $u_1, u_2, \ldots, u_p$ represent p specific factors, including measurement errors and a_{ij}:{$i = 1,\ldots, p; j = 1,\ldots, k$} are the factor loadings, which indicate to what degree observed variables are involved with underlying factor patterns. In addition, common factors are normalized [$E(f_j) = 0$; $Var(f_j) = 1$], specific factors have a mean equal to zero and are uncorrelated [$E(u_i) = 0$; $Cov(u_i, u_l) = 0$; $i \neq l$; i, $l = 1,\ldots, p$] and both common and specific factors are independent [$Cov(f_j, u_i) = 0$; $\forall j = 1,\ldots, k$; $i = 1,\ldots, p$].

Once the observed selected variables are standardized and the model is fully characterized, exploratory factor analysis is performed following a six-step procedure:[5]

i. Calculation of the correlation matrix of observed variables
ii. Assessment of the degree of interdependence between observed variables
iii. Factor extraction
iv. Determination of the number of factors
v. Factor rotation
vi. Computation of factor scores

B. EMPIRICAL STRATEGY AND EMPLOYED DATA

Two exploratory factor analyses are to be carried out in order to correctly identify the underlying TFP and institutional quality factors in Latin America and the Caribbean; consequently, we make use of two different sets of variables.

Regarding institutional quality, we focus on outcome indicators reflecting the latent quality of institutions from economic and sociopolitical perspectives; given our interest in short-term dynamics, we must rely on existing annual data. To this matter, the ten categories of the Heritage Foundation's annual index of economic freedom and the two scores on sociopolitical liberties of the Freedom House's freedom in the world country ratings, from 1995 to 2004, represent the best available sources of institutional quality data for 21 Latin American and Caribbean countries.[6] In order to facilitate comprehension and to comply with most factor extraction methods,

5 See Appendix 3 for a detailed technical description of each one of the steps.

6 See Appendix 2 (tables A2.1 and A2.3) for complete descriptions.

institutional variables from both sources are standardized. In this sense, we adopt a scale ranging from 0.2 to 1; a score of 0.2 denotes the existence of a socioeconomic and political environment not favorable to freedom, while a score of 1 characterizes the existence of a socioeconomic and political environment conducive to freedom. It is important to point out that our scaling actually corresponds to the inverse scale of the Heritage Foundation's indicators, in which different dimensions of economic freedom are rated on a 1 to 5 range: 1 representing the freest economic environments and 5 the least ones. Summary statistics are presented in Table 2.

First of all, we observe that the economic and sociopolitical outcome indicators of institutional quality are quite disappointing in Latin America and the Caribbean during the period under consideration; in fact, most index values are very close to the lower bound of our rating scale (0.2); furthermore, instability also seems to be an issue, particularly with respect to monetary policy and political rights. When decomposing the overall standard deviation of each indicator, we find as expected,

Table 2
Summary Statistics of Selected Institutional Quality Outcome Indicators in Latin America and the Caribbean, 1995-2004

Variable	Obs.	Mean	Standard deviation			Min.	Max.
			Overall	Between	Within		
Trade	210	0.33	0.11	0.08	0.08	0.20	0.67
Fiscal burden	210	0.31	0.06	0.05	0.04	0.21	0.62
Gov't intervention	210	0.41	0.14	0.11	0.08	0.20	1.00
Monetary policy	210	0.36	0.24	0.18	0.15	0.20	1.00
Foreign investment	210	0.46	0.17	0.14	0.11	0.20	1.00
Banking	210	0.42	0.15	0.14	0.07	0.20	1.00
Wages & prices	210	0.45	0.15	0.12	0.08	0.25	1.00
Property rights	210	0.36	0.16	0.16	0.05	0.20	1.00
Regulation	210	0.31	0.08	0.07	0.04	0.20	0.50
Informal market	210	0.28	0.08	0.07	0.04	0.20	0.67
Political rights	210	0.56	0.22	0.19	0.12	0.20	1.00
Civil liberties	210	0.47	0.15	0.13	0.08	0.23	1.00

Note: The first ten indicators are the components of the Heritage Foundation's annual index of economic freedom. The last two indicators correspond to the Freedom House's freedom in the world country ratings. See Appendix 1 for complete definitions.
Source: Author's calculations based on Heritage Foundation (2005) and Freedom House (2005).

given the slow evolution of institutions, that most of the variability is due to differences between countries.

Relating to total factor productivity, we center our attention on 3 measurable variables that we consider are good indicators of the unobserved true characteristics of TFP; these macroeconomic aggregates are: *production, investment and the Solow residual*. Since our interest resides in the analysis of short-term dynamics, we will focus on the cyclic component of each of these variables, derived through Hodrick and Prescott's (1980) detrending procedure.[7] Summary statistics are presented in Table 3.

From a regional perspective, macroeconomic short-term deviations are not very significant in Latin America and the Caribbean, during the 1995-2004 span; nevertheless, at the country-specific level, i. e. the within component of the overall standard deviation, cyclic fluctuations are far more important, notably with regard to investment, as illustrated by the minimal and maximal values observed in the sample. As an example, the investment short-term deviation of -72% corresponds to the case of Venezuela in year 2003, while the 50% positive deviation belongs to Haiti in 1996.

C. MEASURING TOTAL FACTOR PRODUCTIVITY

Following the standard exploratory factor analysis methodology previously evoked and in order to assess the pertinence of the procedure, we start by computing the correlation matrix of our 3 aggregate indicators (Table 4), for the 21 selected Latin American and Caribbean economies during the 1995-2004 period.

As we notice, interdependence among selected indicators is very important, as showed by the significant cross-correlation coefficients and the rejection of the null hypothesis that the variables are noncollinear (Bartlett's test of sphericity), therefore validating the use of factor analysis; furthermore the KMO measure of sampling adequacy is well above the 0.5 generally recommended value.

7 See Appendix 1 (Table A1.2) and Appendix 2 for sources and definitions. It is important to mention that cyclic components are computed for the 1960-2005 period. In order to keep a balanced set of results and accordingly to the time dimension of available institutional data, factor analysis is performed on the 1995-2004 subset.

Table 3
Summary Statistics of Selected Macroeconomic Aggregates in Latin America and the Caribbean, 1995-2004

Variable	Obs.	Mean	Standard deviation			Min	Max
			Overall	Between	Within		
Production	210	0.00	0.04	0.01	0.04	-0.15	0.10
Investment	210	0.01	0.16	0.04	0.16	-0.72	0.50
Solow Residual	210	0.00	0.03	0.01	0.03	-0.15	0.09

Note: Variables measured in terms of deviations from a long term stochastic trend. See Appendix 1 and Appendix 2 for sources and definitions.
Source: Author's calculations.

Table 4
Correlation Matrix of Selected Macroeconomic Aggregates

	Production	Investment	Solow residual
Production	1		
Investment	0.74 *	1	
Solow residual	0.78 *	0.63 *	1
Bartlett's test of sphericity	*Chi-sq:* 359.8	KMO measure	0.709
	p-value: 0.00		

Note: Significant correlations at the 5% level are denoted with an asterisk (for N = 210, ρ = 0.138).
Source: Author's calculations.

Factor extraction is carried out using the maximum likelihood approach. In this sense, one common factor (f_1^{TPF}) is identified based on two broadly used criteria: i) the rejection of the null hypothesis that the number of factors is superior to 1 and ii) a factor contribution superior to 60% of the overall common factor explained variation. In other words, a unique factor, which we associate to actual unobserved total factor productivity, is identified as the main source explaining common short-term variations in our 3 selected macroeconomic aggregates.

Factor rotation is thereafter performed and results are presented in Table 5. Factor loadings a_{ij} : $\{i = 1,2,3; j = 1\}$ are depicted in the second column; they indicate to what extent the latent common factor previously identified (i. e. TFP) is related

Table 5
Rotated Factor: TFP

Variable	Factor loadings (α) f_1^{TFP}	Uniqueness
Production	0.96 *	0.09
Investment	0.77 *	0.41
Solow residual	0.82 *	0.33

Note: Based on oblique promax factor rotation (see Appendix 3).
Significant loadings at the 5% level are denoted with an asterisk (for N = 210, ρ = 0.138).
Source: Author's calculations.

to variations in the observed variables. For instance, factor loadings are very high, thus illustrating the importance of unobserved aggregate productivity; additionally, the uniqueness of each variable, i. e. the proportion of a variable's total variation explained by specific factors (u_i), is relatively low, attaining a maximum of 41% in the case of investment.

Finally, the last step of our factor analysis procedure consists in computing the estimated values of the factor associated to unobservable TFP (f_1^{TPF}), for every country and every period under consideration. In this sense, factor scores are derived, by minimizing the sum of the squares of the specific factors (u_i), through generalized least squares. Table 6 illustrates the main results.

Factors scores are then computed by combining each variable with its corresponding coefficient: $f_{1,q,t}^{TPF} = 0.42 \times production_{q,t} + 0.37 \times investment_{q,t} + 0.38 \times SR_{q,t}$, where q and t respectively represent countries (21) and years (10). As an illustration, Graph 4 depicts the scores related to underlying TFP in the Latin American and Caribbean economies under analysis. The graph portrays the relative levels of total factor productivity in Latin America for years 1995 and 2004[8]. The upper right quadrant depicts the countries for which TFP was above the regional mean in the two years under consideration: these are for example the cases of Brazil, Colombia and Venezuela. Conversely, the lower left quadrant displays the countries for which TFP was below the regional mean; unfortunately, for countries like Haiti and the Dominican

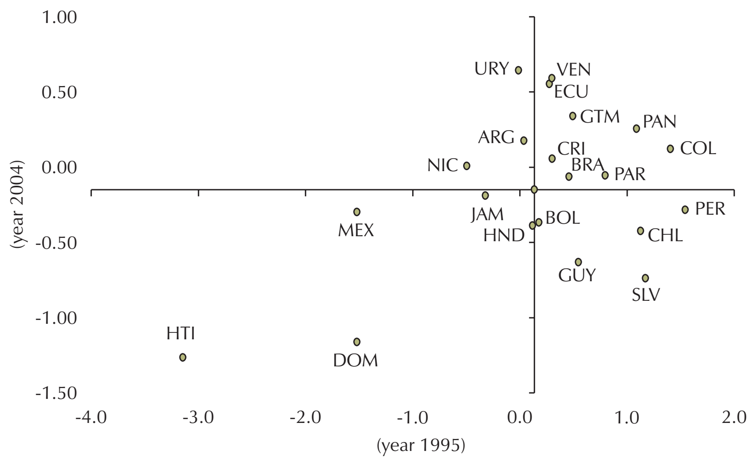
8 It is important to mention that factor scores are presented in differential format; therefore, a score of 0 corresponds to a factor score equal to the sample mean. In the same way a positive (negative) score is equivalent to a score above (below) the sample mean.

Table 6
Scoring Coefficients: TFP

Variable	Factor f_1^{TFP}
Production	0.42
Investment	0.37
Solow residual	0.38

Note: Based on GLS estimation (see Appendix 3).
Source: Author's calculations.

Graph 4
TFP in Latin America and the Caribbean: Factor scores



Note: See Appendix 1 (Table 1.1) for definitions.
In 1995 average TFP deviation was 0.13; while in 2004 it was -0.15.
Source: Author's calculations based on estimated factor scores.

Republic total factor productivity was in average 10 times lower than in the rest of Latin America and the Caribbean.

As previously evoked, Solow decompositions tend to systematically mismeasure actual TFP shifts; to this matter, factor analysis represents an alternative solution, in which the identified common factor, associated to unobserved aggregate productivity (f_1^{TPF}), is by construction independent of specific errors in the observed outcome indicators (u_i), i. e. production, investment and the Solow residual, which could be associated, for example, to qualitative and quantitative changes in the quality of production factors. In this sense, Graph 5 depicts the evolution of the cyclic components of total factor productivity, for a sub-group of Latin American economies, calculated by the standard growth decomposition and exploratory factor analysis.

We observe that total factor productivity measures derived from factor analysis are constantly lower in absolute value, than those obtained from the standard Solow decomposition methodology. A result consistent with the empirical evidence found in the traditional growth accounting literature, where residual approaches are likely to overvaluate shifts in aggregate productivity in the presence of measurement errors.

D. MEASURING INSTITUTIONAL QUALITY

As previously stated, our interest is centered on the underlying elements explaining institutional quality outcome indicators. Following the standard exploratory factor analysis methodology, we start by evaluating the viability of the statistical procedure. To this matter, cross-correlations are computed and adequacy tests are performed. Results, for the 21 selected Latin American and Caribbean economies during the 1995-2004 period, are presented in Table 7.

We observe that significant interdependency among indicators is widespread. Particularly high correlations (above 0.6), which may point towards the existence of common latent factors, are distinguished between *banking and monetary policy*, *property rights and regulation, property rights and the informal market*, as well as between *political rights and civil liberties*. Regarding the adequacy of the sample, to be analyzed via factor analysis, we find that Bartlett's test of sphericity rejects the null hypothesis of independence; additionally, the KMO measure is well above the 0.5 suggested value.

Factor extraction is thereafter performed following the, previously evoked, maximum likelihood approach. A major concern is the determination of the number of factors to be analyzed; in this sense, hypothesis testing, based on nested maximum likelihood estimation, indicates the existence of 6 significant factors; nevertheless, it is well known that this procedure tends to overvaluate the number of factors to be selected, as the number of observed variables increases (Klein, 1994), given that it detects every common factor, even if its explaining power is very low. An alternative selection criterion is based on the cumulative variance contribution of each

Graph 5
Total Factor Productivity: Solow decomposition vs. factor analysis
TFP short-term deviations (percentage)

Note: Dashed lines denote the cyclic component of TFP, measured by factor analysis. Factor scores are expressed in levels, using the sample means of the observed outcome indicators (see Appendix 3, step 6).
Solid lines denote the cyclic component of TFP, measured by the Solow residual (see appendices 1 and 3).
Source: Author's calculations.

Table 7
Correlation Matrix of Selected Institutional Quality Indicators

	Trade	Fiscal burden	Gov't intervention	Monetary policy	Foreign investment
Trade	1.00				
Fiscal burden	0.13	1.00			
Gov't intervention	**0.19** *	0.10	1.00		
Monetary policy	0.03	-0.02	0.12	1.00	
Foreign investment	**0.31** *	0.13	0.11	**0.18** *	1.00
Banking	**0.14** *	-0.06	0.07	**0.62** *	**0.30** *
Wages & prices	**0.41** *	**0.20** *	**0.15** *	**0.31** *	**0.23** *
Property rights	**0.36** *	**0.29** *	**0.31** *	0.04	**0.14** *
Regulation	**0.23** *	**0.15** *	**0.28** *	**0.25** *	**0.25** *
Informal market	**0.25** *	0.10	**0.34** *	**0.26** *	0.10
Political rights	**0.27** *	**0.12** *	0.10	**0.30** *	**0.14** *
Civil liberties	**0.23** *	0.13	**0.19** *	**0.23** *	0.10
Bartlett's test of sphericity		*chi-square:*	909.30		
		p-value:	0.00		

Note: Significant correlations at the 5% level are denoted with an asterisk (for N = 210, ρ = 0.138).
Source: Author's calculations.

unobserved pattern to the overall common factor explained variation; following this procedure 3 factors are retained, which account for 63% of total common factor explained variation. Put differently, 3 institutional underlying patterns or latent dimensions are identified as the main sources explaining common variation in our selected set of 12 institutional quality outcome indicators.

Factor rotation is carried out (Table 8), the objective being to find a parameterization in which each variable has only a small number of large loadings; that is, each variable is affected by a small number of factors. In this sense, loadings $a_{ij} : \{i = 1,2,\ldots,12; j = 1,2,3\}$ are depicted in the second, third and fourth columns; our first common factor (f_1^{POL}) is significantly and positively related to *Wages and Prices, Political rights* and *Civil liberties*; given the social and political dimensions of this factor we associate

	Banking	Wages & prices	Property rights	Regulation	Informal market	Political rights	Civil liberties
	1.00						
	0.28 *	1.00					
	0.04	**0.14** *	1.00				
	0.25 *	**0.21** *	**0.62** *	1.00			
	0.20 *	**0.16** *	**0.73** *	**0.56** *	1.00		
	0.29 *	**0.44** *	**0.28** *	**0.26** *	**0.42** *	1.00	
	0.13	**0.20** *	**0.50** *	**0.30** *	**0.51** *	**0.69** *	1.00
KMO measure of sampling adequacy				0.71			

it to sociopolitical liberties.[9] Our second common factor (f_2^{ECON}), which we associate to economic liberties, is importantly correlated with economic policy aggregates such as *trade, fiscal burden, government intervention, property rights, regulation* and *informal market*. Lastly, our third common factor (f_3^{FIN}), which we interpret as a broad measure of financial liberty, is highly related to *monetary policy*, *foreign investment* and *banking*. To sum up, given the available institutional information,

9 Intuitively, *wages and prices* don't seem to be directly related to sociopolitical liberties, nevertheless this indicator, which is associated to the existence of minimum wage laws and price controls, may be measuring the bargaining power of unions and pressure groups, which in contrast are undoubtedly associated to sociopolitical liberties.

Table 8
Rotated Factors: Institutions

Variable	Factor loadings (α)			Uniqueness
	f_1^{POL}	f_2^{ECON}	f_3^{FIN}	
Wages & prices	0.35 *	0.02	0.26 *	0.75
Political rights	1.01 *	-0.06	0.03	0.00
Civil liberties	0.61 *	0.30 *	-0.07	0.42
Trade	0.15 *	0.31 *	0.05	0.83
Fiscal burden	0.06	0.27 *	-0.11	0.91
Gov't intervention	-0.05	0.34 *	0.11	0.88
Property rights	-0.02	1.02 *	-0.12	0.01
Regulation	-0.04	0.64 *	0.24 *	0.51
Informal market	0.15 *	0.68 *	0.11	0.39
Monetary policy	0.05	-0.00	0.74 *	0.43
Foreign investment	-0.01	0.13	0.31 *	0.88
Banking	0.01	0.00	0.80 *	0.36

Note: See Appendix 1 (Table 1.1) for definitions.
Source: Author's calculations based on estimated factor scores.

we identify sociopolitical, economic and financial liberties[10] as the main common underlying dimensions of institutional quality in our sample of Latin American and Caribbean countries.

Relating to factor loadings, it is important to mention that when identifying common factors, only the largest variable-specific loadings are considered. In fact, we observe that for example *trade* is also significantly correlated with the sociopolitical factor (loading of 0.15); nevertheless, the highest trade-specific loading (0.31) is the one corresponding to the economic liberty factor. Additionally, two factor loadings require a more detailed explanation, these are the cases of the significant loadings associated to *political rights* and *property rights*; we notice that both coefficients are slightly

10 Isaiah Berlin (1969) distinguishes between two concepts of liberty: negative liberty, which refers to an individual's liberty from being subjected to the authority of others; and positive liberty, which is defined in terms of the opportunity and ability to act to fulfill one's own potential. Our indicators appear to be more related to the concept of negative liberty, in the sense that they mostly refer to freedom from coercion.

superior to 1, which means that sociopolitical and economic common factors account for the entire variation in the mentioned indicators. This perfect fit is obtained from the rotation procedure, however, when considering the unrotated factor matrix (results not shown), derived loadings are closer to the 0.90 value. Regarding uniqueness (fifth column of Table 8), we notice that most of the variability in observed indicators is due to specific factors (u_i), which is compatible with the assumption that institutional quality outcome indexes are measured with error.

The next and last step of our factor analysis procedure consists in computing the approximated values of the factors associated to underlying institutional quality ($f_1^{POL}, f_2^{ECO}, f_3^{FIN}$), for every country and every period. As before, factor scores are estimated, by minimizing the sum of the squares of the specific factors (u_i), through generalized least squares. The main results are presented in Table 9.

Factors scores for our three latent institutional quality patterns are then computed by combining each variable, for every period and every country, with its corresponding coefficient. As an illustration, graphs 6 and 7 portray the scores related to sociopolitical,

Table 9
Scoring Coefficients: institutions

Variable	Factors		
	f_1^{POL}	f_2^{ECON}	f_3^{FIN}
Wages & prices	**0.29**	-0.04	0.20
Political rights	**0.61**	-0.08	-0.03
Civil liberties	**0.39**	0.09	-0.09
Trade	0.12	**0.19**	0.02
Fiscal burden	0.07	**0.25**	-0.19
Gov't intervention	-0.12	**0.26**	0.11
Property rights	-0.07	**0.39**	-0.12
Regulation	-0.09	**0.27**	0.13
Informal market	0.05	**0.26**	0.03
Monetary policy	-0.01	-0.04	**0.48**
Foreign investment	-0.06	0.08	**0.36**
Banking	-0.03	-0.04	**0.50**

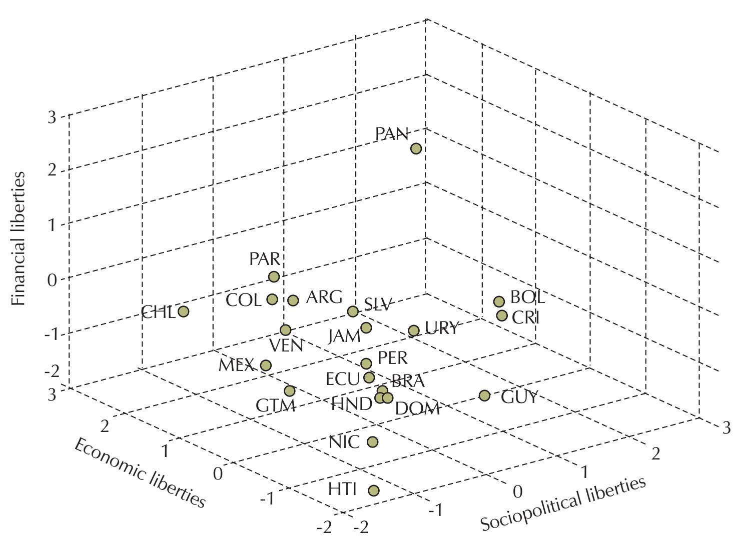
Note: Based on GLS estimation (see Appendix 3).
Source: Author's calculations.

economic and financial liberties in Latin American and the Caribbean, for years 1995 and 2004 (see footnote 8, page 82).

We observe that in 1995 the country with the best relative institutional quality, as measured by our 3 underlying dimensions, is Panama; whereas, the country with the worst relative institutional quality is Haiti. For countries like Costa Rica and Bolivia sociopolitical liberties are very high, conversely, economic liberties in these two countries are closer to the regional mean. Another interesting case is Chile, a country for which institutional quality basically corresponded to economic liberties. Considering the region as a whole, we notice that financial liberty is not very present; in fact, the highest scores are generally associated to economic liberty.

Regarding year 2004 (Graph 7), sociopolitical, economic and financial liberties have positively evolved for most of the countries under analysis. In this sense, the highest relative institutional quality score corresponds to Chile, while the lowest score is for Venezuela. In the case of Chile overall institutional quality increased relative to 1995, thanks to significant improvements in financial and sociopolitical liberties; in

Graph 6
Institutional Quality in Latin America and the Caribbean:
Factor scores for 1995



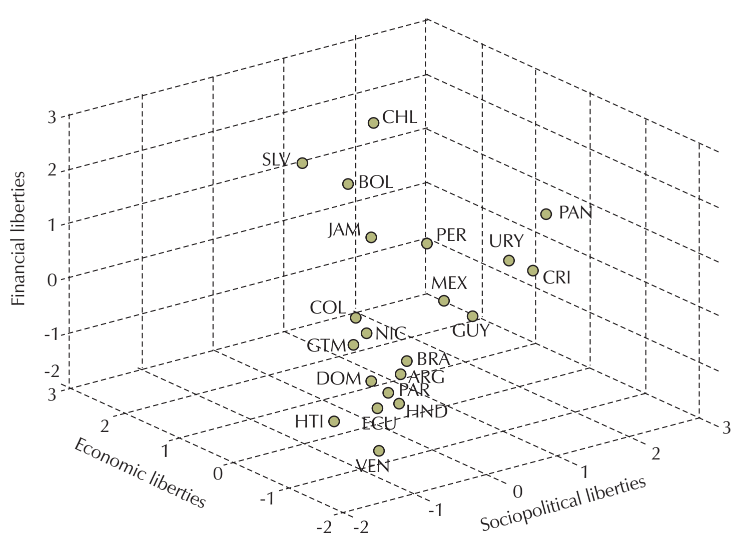
Note: See Appendix 1 (Table 1.1) for definitions
Source: Author's calculations based on estimated factor scores.

this same positive institutional quality tendency, we find countries like El Salvador, Mexico and Peru. On the other side of the spectrum, for countries like Argentina, Paraguay and specially Venezuela, institutional quality has been regressing in each of the three identified dimensions.

In general terms we have managed, through factor analysis, to identify from a given set of macroeconomic aggregates and institutional measures, a relevant group of specific latent patterns that we associate to unobservable total factor productivity and institutional quality in Latin America and the Caribbean. Nevertheless, results are to be interpreted with caution; in fact, the existence of several factor extraction methods, only exceeded by the available number of factor rotation procedures, the relative shortness and reliability of our sample and the subjectivity involved when defining common factors, render any generalization inappropriate. In this sense, our results are consistent given the adopted methodology and the available data.

In the following section, we extend the analysis one step further and try to elucidate the relationship, if there is any, between TFP short-term deviations and institutions.

Graph 7
Institutional Quality in Latin America and the Caribbean:
Factor scores for 2004



Note: See Appendix 1 (Table 1.1) for definitions
Source: Author's calculations based on estimated factor scores.

IV. TOTAL FACTOR PRODUCTIVITY FLUCTUATIONS AND INSTITUTIONS: AN EMPIRICAL ASSESSMENT

A. DATA AND EMPIRICAL FORMULATION

As previously mentioned, we will focus on the existence of a short-term relationship between what has been generally acknowledged as the main source of cyclic fluctuations in the region, i. e. total factor productivity (Hoffmaister and Roldós, 1997; Ahmed, 2003; Arreaza and Dorta, 2004) and the underlying incentive structure in which it builds up, i. e. institutions (North, 1990; Dawson, 1998; Girma *et al*., 2003).

The data employed in this empirical evaluation are the factor scores derived in the preceding section; they are associated to the latent dimensions of TFP and institutional quality. In order to facilitate comprehension, factor scores are converted from their differential format into levels, using the sample means of observed outcome indicators. The sample therefore includes yearly observations covering the 1995-2004 period, for 21 selected Latin American and Caribbean economies (210 observations). Taking advantage of the panel characteristics of our dataset, we adopt the following empirical specification:

$$f_{i,t}^{TFP} = \alpha_0 + \alpha_1 f_{i,t}^{POL} + \alpha_2 f_{i,t}^{ECON} + \alpha_3 f_{i,t}^{FIN} + w_t + v_i + q_{i,t-1} + e_{it} \qquad (2)$$

where $f_{i,t}^{TFP}, f_{i,t}^{POL}, f_{i,t}^{ECON}, f_{i,t}^{FIN}$, correspondingly, denote: underlying total factor productivity, sociopolitical liberty, economic liberty and financial liberty in country (i) at time (t). The vector of time-dummy variables controlling for common time-varying-effects is represented by w_t, whereas, country-specific unobservable heterogeneity is represented by v_i. Country-specific time varying effects, associated to international shocks, are approximated by changes in the terms of trade and denoted by $q_{i,t-1}$; we use one-period lagged values of the terms of trade in order to reduce the risk of endogeneity and assuming that international shocks do not immediately translate into cyclic deviations at the country level. Finally $e_{i,t}$ depicts idiosyncratic disturbances. It is important to mention that the assumed functional form suggests the existence of perfect substitutability between institutional factors; in this sense, even though this assumption may seem unrealistic, the adoption of a more complex functional form in which, for example, institutional factors could be complementary, would entail the existence of a well defined theoretical framework. Since our approach is rather exploratory we prefer to adopt an empirical specification easier to interpret.

Regarding the expected effects of each institutional quality dimension on the cyclic component of aggregate productivity, we rely on previous analyses borrowed manly from the literature on the deep sources of growth; even though our focus is not on long-term relationships this literature provides good insight into the various institutional mechanisms that contribute to economic growth. In this sense, conflicting interpretations sometimes arise; for instance, the presence or the absence of democracy, which can be considered as a reflection of the state of sociopolitical liberties, has been found to have an ambiguous impact on growth; from a theoretical perspective, democratic regimes are deemed to credibly commit to protect and enhance property rights and contracts (Olson, 1993; Clague *et al*., 1996), nevertheless, democracy can also represent a risk to sustainable growth, given that it may be susceptible to pressures from interest groups, which may induce growth-deterring policies (Persson and Tabellini, 1992). From an empirical perspective, the overall effect of democracy on growth is found to be weakly negative and nonlinear or simply inexistent (Barro, 1996; Alesina *et al*., 1996). Relating to the soundness of economic policy, which can be associated to our definition of economic liberty and its impact on economic activity, the empirical literature consistently points towards the existence of a positive significant relationship between sound macroeconomic policies and growth (Acemoglu *et al*., 2001; Rodrik *et al*., 2004). From a microeconomic perspective, institutions may also play a determinant role on the evolution of aggregate TFP when considering restructuring and reallocation at the firm level. For instance, institutional change, as measured by policy reforms, may translate into increased productivity by favoring allocative efficiency, i.e. the concentration of activities in more productive plants in a given sector, as demonstrated by Eslava *et al*. (2006) in the case of Colombia. Lastly, in relation to financial liberties, two distinct arguments are generally advanced; on the one hand, financial development is supposed to have a positive impact on growth by reducing information and transaction costs, which in turn facilitate capital accumulation and technological innovation (Levine, 1997); on the other hand, financial liberalization is deemed to negatively impact growth in developing countries by making economies more prone or vulnerable to banking and currency crises, given the existence of asymmetric information in financial markets and the lack of appropriate regulatory frameworks (Andersen and Tarp, 2003; Loayza and Rancière, 2005).

B. ESTIMATION RESULTS

Before embarking on the econometric estimation of equation (2), it is important given the relative long time dimension of our dataset, to test weather our series are stationary or not; In fact, the presence of unit roots could seriously undermine the reliability of standard regression analysis, by implying the acceptance, based on biased significance statistics, of spurious relationships. To this matter, we implement the Levin, Lin and Chin (2002) test, where the null hypothesis is that all variables are non stationary; based on an augmented Dickey-Fuller regression, the procedure imposes homogeneity on the autoregressive coefficients, which indicate the presence or absence of a unit root, while the intercept and the trend can vary across individual series; three sets of tests, with country-specific constants and trends, are performed; different lags of the dependent variables are used in order to correct for the possible presence of correlation in the residuals; results are presented in Table 10.

We notice that the null hypothesis of non-stationarity is rejected at the 1% significance level in almost every case, with the exception of the financial liberty variable when 2 lags are included in the augmented Dickey-Fuller estimation; nevertheless in this last case, acceptance of the null is very close to the rejection area. Therefore, in general terms, selected variables can be considered to be stationary.

Turning now to the empirical specification depicted in equation (2), we evaluate the relationship between institutional liberties and the cyclic element of factor productivity by means of the fixed effects estimator (FE). The reason for using fixed effects rather than random effects relies on the assumption that time-invariant unobserv-

Table 10
Levin, Lin, and Chin Panel Unit Root Tests

Variable	Lag(0)	Lag(1)	Lag(2)
$f_{i,t}^{TFP}$	-4.50 (0.000)	-5.51 (0.000)	-15.49 (0.000)
$f_{i,t}^{POL}$	-6.63 (0.000)	-3.46 (0.000)	-6.76 (0.000)
$f_{i,t}^{ECO}$	-12.48 (0.000)	-4.86 (0.000)	-4.23 (0.000)
$f_{i,t}^{FIN}$	-7.55 (0.000)	-5.34 (0.000)	-1.05 (0.147)
Observations	189	168	147

Note: Tests performed with country-specific constants and trends. P-values in parentheses.
Source: Author's calculations.

able heterogeneity, as for example geographical location, is correlated with the latent dimensions of institutional quality (sociopolitical, economic and financial liberties). Fixed effects estimations and post-estimation tests (autocorrelation and heteroskedasticity) are presented in Table 11; the first column corresponds to the results obtained from using the entire sample of 21 countries, while the second and third columns correspond to the estimates derived from subsamples of Andean and Mercosur countries. When considering the entire sample, we observe that economic and financial liberties are quite significant in explaining short-term TFP deviations. For instance, economic liberty is, as expected, positively related to aggregate factor

Table 11
Fixed Effects Estimation

Variable	All countries (3)	ACN (4)	Mercosur (5)
Sociopolitical liberty	-0.118	-0.057	0.014
	(-0.68)	(-0.18)	(0.02)
Economic liberty	0.866 **	0.178	1.619 *
	(2.41)	(0.20)	(2.03)
Financial liberty	-0.440 **	-0.417	-0.683 *
	(-2.21)	(-0.82)	(-1.77)
R-squared			
Variable	All countries (3)	ACN (4)	Mercosur (5)
within	0.347	0.551	0.755
between	0.013	0.644	0.319
overall	0.196	0.453	0.696
Post-estimation tests			
Variable	All countries (3)	ACN (4)	Mercosur (5)
heteroskedasticity	$Chi^2(21)$ = 2,118.09	$Chi^2(5)$ = 44.11	$Chi^2(4)$ = 6.16
p-value	0.000	0.000	0.187
autocorrelation	$F(1,20)$ =16.96	$F(1,4)$ = 6.68	$F(1,3)$ = 47.18
p-value	0.000	0.061	0.006
Observations	210	50	40

Note: Dependent variable: cyclic component of TFP, derived by factor analysis. Intercepts, time dummies and controls are omitted. *t-statistics* in parentheses. 10% significance is denoted by (*), 5% is denoted by (**) and 1% is denoted by (***).
Source: Author's calculations.

productivity, whereas, the relationship between TFP and financial liberty is negative, apparently corroborating the vulnerability argument; regarding sociopolitical liberty, its impact is far from being relevant, in accordance with most of the empirical literature previously evoked and the fact that sociopolitical changes are not very recurrent in the short-term. In the cases of the Andean and Mercosur countries, we notice that for the former, no explaining variable is significantly related to factor productivity, while for the latter sub-regional group, a weakly significant relation is found between TFP and both economic and financial liberties.

Results are however to be taken with caution, since heteroskedasticity (Breusch-Pagan test) and autocorrelation (Wooldridge test) are significantly present in the residuals (bottom part of Table 11, column 3), consequently, the fixed effects estimator may be inefficient and severely biased. Another serious limitation is related to the endogeneity of the explicative variables; in fact, it is reasonable to assume that total factor productivity could also have an impact on institutional quality indicators, given that TFP variations would translate into growth fluctuations, which in turn could influence the adoption of policies and the overall evolution of sociopolitical, economic and financial liberties. In order to cope with these shortcomings, the model presented in equation (2) is estimated using the instrumental variable (IV) approach, assuming that latent institutional quality indicators are endogenously determined and correcting for the presence of heteroskedasticity and autocorrelation in the residuals. Results are presented in Table 12.

First stage estimations are depicted in columns 6 to 8; to this matter, a major concern is the selection of instruments, in fact, we are looking for variables that are strongly correlated with our measures of sociopolitical, economic and financial liberties and at the same time independent of total factor productivity. As is generally the case in empirical macroeconomics, good instruments are difficult to find, even more, when trying to identify the impact of institutional variables on aggregate growth. In this sense, the temporal dimension of our dataset impedes the utilization of generally accepted institutions-related instruments such as initial geographical conditions or specific colonization characteristics (Acemoglu *et al*., 2001, 2003), which in our case, are accounted for through the fixed effects within transformation. Consequently, we use lagged values of the endogenous variables, i.e. institutional liberties, as well as exogenous time-period dummies and lagged international shocks as instruments; in order to reduce as much as possible the risk of correlation between the institutional instruments and the error term ($e_{i,t}$) we employ two-period lags. Taking a closer look at first stage regressions, we observe that instruments are highly correlated with the

Table 12
Fixed Effects Instrumental Variable Estimation

Variable	Sociopolitical liberty (6)	Economic liberty (7)	Financial liberty (8)	TFP (9)
Sociopolitical liberty (*t*-2)	**0.443** ***	-0.064	-0.018	---------
	(3.00)	(-1.23)	(-0.16)	---------
Economic liberty (*t*-2)	**0.446** **	**0.228** ***	**0.433** *	---------
	(2.24)	(3.43)	(1.71)	---------
Financial liberty (*t*-2)	-0.123	-0.065	**0.370** **	---------
	(-0.93)	(-1.17)	(2.54)	---------
Sociopolitical liberty	---------	---------	---------	-0.558
	---------	---------	---------	(-0.84)
Economic liberty	---------	---------	---------	**3.430** *
	---------	---------	---------	(1.87)
Financial liberty	---------	---------	---------	**-1.136** **
	---------	---------	---------	(-2.02)
Centered R-squared	0.223	0.295	0.268	0.251

Post-estimation tests

Variable	Sociopolitical liberty (6)	Economic liberty (7)	Financial liberty (8)	TFP (9)
excluded instruments (Shea)	$F(3,136) = 5.57$	$F(3,136) = 4.20$	$F(3,136) = 9.71$	---------
p-value	0.001	0.007	0.000	---------
underidentification (Anderson)	---------	---------	---------	$Chi^2(1) = 10.07$
p-value	---------	---------	---------	0.002
Observations	168	168	168	168
Regressors	---------	---------	---------	11
Instruments	---------	---------	---------	11
Excluded instruments	---------	---------	---------	3

Note: Intercepts, time dummies and controls are omitted. Computed small sample standard-errors are corrected for the presence of heteroskedasticity and autocorrelation. *t-statistics* in parentheses. 10% significance is denoted by (*), 5% is denoted by (**) and 1% is denoted by (***).
Source: Author's calculations.

endogenous variables, as illustrated by the strong rejection of the null hypothesis of the importance of excluded instruments (Shea, 1997); furthermore and from an institutional perspective, lagged economic liberty appears to significantly influence current sociopolitical and financial liberties (columns 6 to 8). Turning now to the instrumented second stage equation (column 9), we notice that estimated coefficients corroborate the outcome previously determined via OLS fixed effects estimation (Table 11); additionally, the existence of correlation between our set of instruments and the residual, i.e. model underidentification, is strongly rejected (Anderson's canonical correlation likelihood test).[11]

In terms of results, sociopolitical liberty is not importantly correlated with the cyclic component of TFP, whereas, economic and financial liberties appear to be significantly so. Consequently, it is reasonable to assume that sound macro policies such as openness to trade, fiscal stability or reduced government intervention foster economic growth not only in the long-run but also at business cycle frequencies. In relation to financial liberties, our results point towards the short-term vulnerability hypothesis (Loayza and Rancière, 2005), which asserts that in the presence of asymmetric information in financial markets and deficient regulatory frameworks, as is the case in most Latin American and Caribbean countries, financial liberalization may negatively affect growth.

Regarding the hypothesized functional relationship between short-term TFP and institutional quality, some changes are introduced with the aim of accounting for the high degree of persistence generally observed, when empirically analyzing the short-term evolution of factor productivity (Kydland and Prescott, 1982; Long and Plosser, 1983). To this matter, one-period lagged TFP is incorporated in the functional form:

$$f_{i,t}^{TFP} = \alpha_0 + \beta_1 f_{i,t-1}^{TPF} + \alpha_1 f_{i,t}^{POL} + \alpha_2 f_{i,t}^{ECON} + \alpha_3 f_{i,t}^{FIN} + w_t + v_i + e_{it} \quad (3)$$

as previously stated, $f_{i,t}^{TFP}, f_{i,t}^{POL}, f_{i,t}^{ECON}, f_{i,t}^{FIN}$ depict underlying total factor productivity, sociopolitical liberty, economic liberty and financial liberty in country (*i*) at time (*t*). The vector of time-dummy variables controlling for common time-varying-effects is

11 The null hypothesis of the test is that the matrix of reduced form coefficients is not of full rank, i. e. the equation is underidentified. The test statistic provides a measure of instrument relevance, and rejection of the null indicates that the model is identified (Hall *et al.*, 1996).

represented by w_t, whereas, country-specific unobservable heterogeneity is represented by v_i. Finally $e_{i,t}$ depicts idiosyncratic disturbances.

Given the presence of the autoregressive parameter (β_1), the relatively small time-dimension of our dataset and the existence of endogeneity, equation (3) is empirically approximated using the system generalized method of moments estimator (S-GMM) suggested by Arellano and Bover (1995) and further developed by Blundell and Bond (1998). To this matter, 2-period lagged differences of the variables (*t*-2) are used as instruments for the equations in levels; additionally, 2-period lagged levels (*t*-2) are employed as instruments for the equations in first differences. In order to detect whether serious sample biases are present in our analysis, the factor productivity-institutions relationship is also estimated by using standard ordinary least squares (OLS) and fixed effects (FE). Results are depicted in Table 13.

As it is generally acknowledged, the autoregressive coefficient (β_1) is expected to be biased upwards, when estimated by OLS, due to correlation of the lagged dependent variable with the country-specific effects. Conversely, the autoregressive parameter is deemed to be biased downwards, when estimated by fixed effects, given that by eliminating the unknown country-specific effects from each observation, through the within transformation, correlation between the explanatory variables and the residuals is created.

From an econometric perspective, S-GMM estimation is fairly robust, the coefficient of lagged total factor productivity lies, as expected, between the upper OLS and lower FE boundaries; moreover, instruments adequacy is confirmed by the non rejection of the null hypothesis of system overidentification (Hansen's test), the presence of first order autocorrelation and the absence of second order residual correlation (Arellano and Bond's tests). From an economic perspective, results indicate that once dynamic effects are taken under consideration, only economic liberty exerts a significant and positive impact on aggregate factor productivity; corroborating again the importance of sound economic policies at business cycle frequencies.

C. ROBUSTNESS CHECKS

In order to corroborate the consistency of our empirical procedure, we perform three additional estimation exercises based on different specifications of the functional form, employing raw data and using an alternative factor extraction methodology.

Table 13
Dynamic Estimations: OLS, FE, S-GMM

Variable	OLS (10)	Fixed effects (11)	System GMM (12)
TFP (*t*-1)	**0.453** ***	**0.418** ***	**0.442** **
	(7.15)	(6.12)	(2.11)
Sociopolitical liberty	0.013	-0.102	-0.210
	(0.16)	(-0.66)	(-0.53)
Economic liberty	0.023	0.472	1.256 *
	(0.21)	(1.34)	(1.82)
Financial liberty	-0.123	**-0.608** ***	-0.284
	(-1.50)	(-3.28)	(-0.62)
R-squared	0.481	0.370	0.290

Post-estimation tests

Variable	OLS (10)	Fixed effects (11)	System GMM (12)
overidentification (Hansen)	---------	---------	Chi2(8) = 8.66
p-value	---------	---------	0.371
AR(1) (Arellano-Bond)	---------	---------	*z* = -2.17
p-value	---------	---------	0.030
AR(2) (Arellano-Bond)	---------	---------	*z* = -1.57
p-value	---------	---------	0.116
Observations	189	189	189
Instruments	---------	---------	21

Note: Dependent variable: cyclic component of TFP, derived by factor analysis. Intercepts and time dummies are omitted. *t-statistics* in parentheses. 10% significance is denoted by (*), 5% is denoted by (**) and 1% is denoted by (***). The S-GMM R-squared corresponds to the correlation coefficient between the cyclic component of TFP, derived by factor analysis, and its estimated counterpart.
Source: Author's calculations.

With regards to the empirical specification depicted in equation (2), we test the reliability of our results by progressively introducing nonlinearities among current and one-period lagged institutional quality indicators (interaction and squared variables); estimations are performed using the fixed effects estimator and results are presented in tables 14 and 15.

When considering the inclusion of contemporaneous interaction variables (Table 14, upper quadrant), economic liberty appears, in all of the cases, to be significantly positively correlated with the cyclic component of TFP. On the other hand, financial liberty is only statistically relevant in one alternative specification (column 13), an issue mainly explained by the possible presence of multicollinearity among explicative variables, as illustrated by the high degree of significance (5%) of the interaction variable associated to sociopolitical and financial liberties. Regarding this last relationship, not much can be interpreted from the results, besides the existence of some form of negative co-movement with factor productivity, given that both indicators are statistically insignificant at the individual level.

Correspondingly, when squared variables are introduced (Table 14 lower quadrant), results remain consistent: economic liberty has the expected sign and is very significant in all of the empirical representations; additionally, financial liberty is significantly negatively related to the cyclic element of TFP in three out of seven estimated equations (columns 20, 21 and 23). In the same way, the squared value of sociopolitical liberty is the only transformed institutional quality indicator to be continuously correlated with factor productivity (columns 20, 23, 24 and 26), which would entail that even if sociopolitical changes in levels are not significantly related to fluctuations in TFP, given their low persistence, the volatility or amplitude of those changes are indeed important at business cycle frequencies.

Turning now to the inclusion of one-period lagged values of our institutional indicators (Table 15), we observe that economic and financial liberties are both significantly related to short-term fluctuations in total factor productivity (column 27).

When introducing lagged interactions and lagged squared variables results remain roughly the same as those shown in Table 14. Economic liberty is broadly significant and positively correlated with TFP; furthermore, financial liberty becomes more relevant from a statistical point of view. Another interesting result is that all squared variables are significantly related to the cyclic component of factor productivity (Table 15, lower quadrant), a fact that seems to corroborate the short to medium-term importance that volatility or the amplitude of changes may have in explaining aggregate fluctuations.

Ideally, estimations should also be carried out with alternative datasets; nevertheless, finding institutional data series for a long enough period of time, which would cover several dimensions of institutional quality as the Heritage Foundation's index

Table 14
Alternative Functional Forms: Fixed effects estimations (current period)

Variable	(3)	(13)	(14)
$f_{i,t}^{POL}$	-0.12	0.04	0.34
	(-0.68)	(0.17)	(1.23)
$f_{i,t}^{ECO}$	**0.87** **	**0.99** **	**0.68** *
	(2.41)	(2.55)	(1.86)
$f_{i,t}^{FIN}$	**-0.44** **	**-0.41** **	**-0.16**
	(-2.21)	(-2.04)	(-0.66)
$f_{i,t}^{POL} \times f_{i,t}^{ECO}$	---------	-0.26	---------
	---------	(-0.84)	---------
$f_{i,t}^{POL} \times f_{i,t}^{FIN}$	---------	---------	**-0.67** **
	---------	---------	(-2.13)
$f_{i,t}^{ECO} \times f_{i,t}^{FIN}$	---------	---------	---------
	---------	---------	---------
R-squared	0.20	0.21	0.19
Observations	210	210	210
Variable	**(3)**	**(20)**	**(21)**
$f_{i,t}^{POL}$	-0.12	0.57	-0.12
	(-0.68)	(1.45)	(-0.71)
$f_{i,t}^{ECO}$	**0.87** **	**0.99** ***	**1.40** **
	(2.41)	(2.73)	(2.46)
$f_{i,t}^{FIN}$	**-0.44** **	**-0.45** **	**-0.44** **
	(-2.21)	(-2.27)	(-2.21)
$f_{i,t}^{POL} \times f_{i,t}^{POL}$	---------	**-0.40** *	---------
	---------	(-1.95)	---------
$f_{i,t}^{ECO} \times f_{i,t}^{ECO}$	---------	---------	-0.56
	---------	---------	(-1.20)
$f_{i,t}^{FIN} \times f_{i,t}^{FIN}$	---------	---------	---------
	---------	---------	---------
R-squared	0.20	0.18	0.23
Observations	210	210	210

Note: Dependent variable: cyclic component of TFP, derived by factor analysis. Intercepts, time dummies and controls are omitted. *t-statistics* in parenthese. 10% significance is denoted by (*), 5% is denoted by (**) and 1% is denoted by (***).
Source: Author's calculations.

	(15)	(16)	(17)	(18)	(19)
	-0.10	0.53	0.02	0.33	0.56
	(-0.56)	(1.57)	(0.09)	(1.22)	(1.54)
	1.02 **	**0.82** **	**1.04** **	**0.76** *	**0.77** *
	(2.35)	(2.09)	(2.39)	(1.69)	(1.72)
	-0.33	**-0.12**	**-0.37**	**-0.11**	**-0.16**
	(-1.21)	(-0.50)	(-1.32)	(-0.39)	(-0.54)
	---------	-0,30	-0,21	---------	-0,34
	---------	(-0.97)	(-0.60)	---------	(-0.95)
	---------	**-0.69** **	**---------**	**-0.65** **	**-0.70** **
	---------	(-2.19)	---------	(-2.05)	(-2.18)
	-0.29	---------	-0.13	-0.14	0.12
	(-0.64)	---------	(-0.25)	(-0.30)	(0.23)
	0.20	0.20	0.21	0.19	0.20
	210	210	210	210	210
	(22)	(23)	(24)	(25)	(26)
	-0.19	0.57	0.53	-0.20	0.53
	(-1.07)	(1.44)	(1.36)	(-1.11)	(1.25)
	0.74 **	**1.52** ***	**0.85** **	**1.29** **	**1.41** **
	(2.01)	(2.69)	(2.32)	(2.28)	(2.51)
	0.08	**-0.45** **	0.12	0.10	0.14
	(0.20)	(-2.28)	(0.31)	(0.25)	(0.36)
	---------	**-0.40***	**-0.43** **	---------	**-0.43** **
	---------	(-1.96)	(-2.07)	---------	(-2.09)
	---------	-0.57	---------	-0.60	-0.61
	---------	(-1.22)	---------	(-1.28)	(-1.31)
	-0.39	---------	**-0.42** *	-0,40	**-0.44** *
	(-1.50)	---------	(-1.66)	(-1.56)	(-1.73)
	0.19	0.22	0.18	0.21	0.21
	210	210	210	210	210

Table 15
Alternative Functional Forms: Fixed effects estimations (lagged period)

Variable	(27)	(28)	(29)
$f_{i,t-1}^{POL}$	-0.21	0.15	-0.004
	(-1.10)	(0.56)	(-0.02)
$f_{i,t-1}^{ECO}$	0.68 *	1.00 **	0.60
	(1.85)	(2.49)	(1.59)
$f_{i,t-1}^{FIN}$	-0.59 **	-0.56 **	-0.47 *
	(-2.55)	(-2.41)	(-1.76)
$f_{i,t-1}^{POL} \times f_{i,t-1}^{ECO}$	---------	-0.64 *	---------
	---------	(-1.86)	---------
$f_{i,t-1}^{POL} \times f_{i,t-1}^{FIN}$	---------	---------	-0.31
	---------	---------	(-0.98)
$f_{i,t-1}^{ECO} \times f_{i,t-1}^{FIN}$	---------	---------	---------
	---------	---------	---------
R-squared	0.23	0.27	0.22
Observations	189	189	189
Variable	**(27)**	**(35)**	**(36)**
$f_{i,t-1}^{POL}$	-0.21	0.58	-0.21
	(-1.10)	(1.45)	(-1.09)
$f_{i,t-1}^{ECO}$	0.68 *	0.79 **	1.44 **
	(1.85)	(2.14)	(2.48)
$f_{i,t-1}^{FIN}$	-0,59 **	-0.60 ***	-0.58 **
	(-2.55)	(-2.64)	(-2.50)
$f_{i,t-1}^{POL} \times f_{i,t-1}^{POL}$	---------	-0.49 **	---------
	---------	(-2.23)	---------
$f_{i,t-1}^{ECO} \times f_{i,t-1}^{ECO}$	---------	---------	-0.79 *
	---------	---------	(-1.69)
$f_{i,t-1}^{FIN} \times f_{i,t-1}^{FIN}$	---------	---------	---------
	---------	---------	---------
R-squared	0.23	0.21	0.26
Observations	189	189	189

Note: Dependent variable: cyclic component of TFP, derived by factor analysis. Intercepts, time dummies and controls are omitted.
t-statistics in parentheses. 10% significance is denoted by (*), 5% is denoted by (**) and 1% is denoted by (***).
Source: Author's calculations.

	(30)	(31)	(32)	(33)	(34)
	-0.21	0.46	0.17	-0.01	0.51
	(-1.07)	(1.27)	(0.59)	(-0.03)	(1.34)
	0.86 *	0.94 **	0.96 **	0.76	0.83 *
	(1.81)	(2.29)	(2.03)	(1.56)	(1.72)
	-0.46	-0.39	-0.60 *	-0.36	-0.48
	(-1.47)	(-1.46)	(-1.87)	(-1.08)	(-1.42)
	---------	-0.70 *	-0.67 *	---------	-0.78 **
	---------	(-2.04)	(-1.77)	---------	(-2.02)
	---------	-0.41	---------	-0.30	-0,44
	---------	(-1.29)	---------	(-0.93)	(-1.34)
	-0.30	---------	0.12	-0,27	0,25
	(-0.60)	---------	(0.21)	(-0.52)	(0.43)
	0.23	0.25	0.27	0.22	0.24
	189	189	189	189	189
	(37)	(38)	(39)	(40)	(41)
	-0.28	0.57	0.59	-0.28	0.58
	(-1.43)	(1.42)	(1.48)	(-1.46)	(1.46)
	0.50	1.52 **	0.59	1.33 **	1.40 **
	(1.33)	(2.64)	(1.58)	(2.29)	(2.45)
	0.12	-0.59 **	0.21	0.20	0.29
	(0.25)	(-2.59)	(0.47)	(0.43)	(0.65)
	---------	-0.48 **	-0.54 **	---------	-0.53 **
	---------	(-2.20)	(-2.48)	---------	(-2.47)
	---------	-0.76 *	---------	-0.87 *	-0.85 *
	---------	(-1.65)	---------	(-1.87)	(-1.86)
	-0.54*	---------	-0.63 **	-0.59 *	-0.68 **
	(-1.79)	---------	(-2.09)	(-1.96)	(-2.26)
	0.19	0.25	0.19	0.20	0.20
	189	189	189	189	189

actually does, is not an easy task.[12] To this matter, we follow a second best strategy; in the first place, we perform estimations using the cyclic component of TFP as measured by the detrended Solow residual. Next, we derive a new set of latent institutional and aggregate productivity scores from the same original variables, using this time an alternative factor extraction methodology: the iterative principal axis approach introduced in Appendix 3 (factor extraction results not shown). Estimation results are presented in Table 16.

Table 16
IV and System-GMM Estimations: Alternative variables

Variable	Solow residualº		Principal axis	
	I.V (44)	System GMM (45)	I.V (42)	System GMM (43)
TFP (*t*-1)	---------	0,45 **	---------	0,44 *
	---------	(2.21)	---------	(2.16)
Sociopolitical liberty	-3.82	-0.28	0,74	0.16
	(-1.12)	(-1.65)	(0.74)	(0.29)
Economic liberty	2,38 **	0.77 *	2,37 *	0,86 *
	(2.43)	(1.76)	(1.85)	(1.85)
Financial liberty	-0.57 **	-0.18	-1.43 *	-0.51
	(-2.02)	(-0.92)	(-1.86)	(-0.84)
R-squared	0.08	0.21	0.24	0.28
Observations	168	189	168	189

Note: Intercepts, time dummies and controls are omitted. t-statistics in parentheses. 10% significance is denoted by (*), 5% is denoted by (**) and 1% is denoted by (***). First stage results not presented. º Short-term TFP fluctuations are approximated by the cyclic component of the Solow Residual (see Appendices 1 and 2).The S-GMM R-squared corresponds to the correlation coefficient between the cyclic component of TFP, derived by factor analysis, and its estimated counterpart.
Source: Author's calculations.

Estimation results using raw factor productivity (Table 16, left quadrant) are fairly similar to those obtained when TFP is approximated by factor analysis (tables 12 and 13): economic liberty is significant and positive in both static and dynamic representations (equations 2 and 3), whereas financial liberty is negatively correlated with aggregate productivity in the static functional form; nevertheless, coefficients

12 For a good survey of currently available institutional quality datasets, see IMF (2005).

are smaller and the overall relationships a little weaker, although still significant, a finding consistent with the assumption that raw TFP is importantly mismeasured. Even more interesting is the contrast with estimates based on raw institutional quality measures (Table 1); from a situation in which no clear empirical linkages could be established between TFP fluctuations and institutional quality, exploratory factor analysis has consistently facilitated the identification of robust co-movement relations. Finally, when employing the alternative factor extraction methodology (Table 16, right quadrant), estimation results remain consistent with those derived through the maximum likelihood approach (tables 12 and 13).

In general, our robustness tests point towards the acceptance of the TFP fluctuations-economic liberty relationship, for a wide number of empirical representations, as well as alternative factor extraction and aggregate productivity measurement methodologies. In this sense, a unit positive shock to economic liberty, roughly translates into a TFP positive deviation comprised between 0.6 and 2.5 points. With regards to financial liberty, results are however less significant. In fact, financial liberty only appears to be strongly and consistently correlated with the cyclic component of TFP when considering results from the instrumental variable approach (tables 12 and 16). As previously indicated, we use two-period lagged values of the endogenous variables (institutional quality indicators) as instruments; consequently and given the relatively low relevance of financial liberty when testing alternative functional forms, it seems reasonable to assume that this institutional indicator may not be contemporaneously linked to aggregate factor productivity. Therefore, some form of lagged or time-delayed relationship is to be further explored.

V. CONCLUDING REMARKS

This paper analyzes the link between total factor productivity changes and institutional quality in 21 Latin American and Caribbean countries, from 1995 to 2004. Abandoning the traditional long-term focus generally acknowledged in the economic growth literature, we center our attention on the short-term implications that institutional quality changes may have on the main identified source of cyclic fluctuations in the region: total factor productivity innovations.

A particular consideration is given to the problem of empirically quantifying underlying aggregate factor productivity and institutional quality; our approach therefore consists in extracting unobservable TFP and institutional quality measures from two sets of observable outcome indicators, through the use of factor analysis techniques. To this matter, we manage to derive an observable indicator of latent aggregate productivity, as well as three complementary indexes of underlying institutional quality, which we associate to sociopolitical, economic and financial liberties. In general terms, resulting institutional scores have positively evolved for most of the countries under analysis, thanks to significant improvements in financial and sociopolitical liberties.

When exploring the relationship between TFP and institutional quality's latent factors, via fixed effects instrumental variables estimation, we find that sociopolitical liberty has no significant impact on short-term TFP, whereas economic and financial liberties are strongly correlated with it; furthermore, economic liberties such as openness to trade, fiscal balance and reduced government intervention, are found to enhance factor productivity at business cycle frequencies, while financial liberties, as for example reduced banking sector control, appear to be negatively related with total factor productivity changes, therefore reinforcing the financial liberalization-vulnerability hypothesis. Nevertheless, when adopting a more dynamic model specification, economic liberty, i.e. sound economic policy, appears as the sole significant explaining factor.

To finish, future extensions of this work should be directed toward two areas: first, the empirical assessment, based on a broader dataset and a richer specification, of the factor productivity and institutional quality interactions and second, the theoretical formalization of the relationship in terms of a dynamic general equilibrium framework.

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APPENDIX 1
Data Sources and Definitions

Table A1.1
Selected Latin American and Caribbean countries

Country	Code
Argentina	ARG
Bolivia	BOL
Brazil	BRA
Chile	CHL
Colombia	COL
Costa Rica	CRI
Dominican Republic	DOM
Ecuador	ECU
El Salvador	SLV
Guatemala	GTM
Guyana	GUY
Haiti	HTI
Honduras	HND
Jamaica	JAM
Mexico	MEX
Nicaragua	NIC
Panama	PAN
Paraguay	PRY
Peru	PER
Uruguay	URY
Venezuela	VEN

Table A1.2
Economic Variables

Variables	Definition	Source	Period
Gross Domestic Product	GDP at constant US$ (2000)	World Development Indicators (2005)	1960-2005
Gross investment	Gross fixed capital formation at constant US$ (2000)	World Development Indicators (2005)	1960-2005
Labor force	Economically active population	World Development Indicators (2005)	1960-2005
Capital stock	Perpetual inventory method (OECD, 1998)	Own calculations based on WDI (2005)	1960-2005
Terms of trade	Price of exports/ Price of imports	Own calculations based on WDI (2005)	1980-2004
Solow residual	See Apendix II	Own calculations based on WDI (2005)	1960-2005

Table A1.3
Institutional Variables

Variables	Definition	Source
Governance indicator	Arithmetic mean of six governance indicators: Voice and accountability Political atability Government effectiveness Regulatory quality Rule of law Control of corruption	Kaufmann, Kraay and Mastruzzi (2005)
Fraser index	Arithmetic mean of five economic indicators: Size of government Legal structure and security of property rights Access to sound money Freedom to trade internationally Regulation of credit, labor, and business	Gwartney and Lawson (2004)
Heritage index	Arithmetic mean of the ten following economic indicators:	Heritage Foundation (2005)
Trade policy	Weighted average tariff rate, non tariff barriers, Corruption in the custom service	
Fiscal burden of government	Top marginal income and corporate taxe rates, annual change in government expenditure	
Government intervention	Government consumption and ownership of industries, Economic output produced by government	
Monetary policy	Weighted average inflation rate (ten years)	
Foreign investment	FDI, restrictions and requirements on foreign companies	
Banking and finance	Government ownership of financial institutions, restrictions and regulations	
Wages & prices	Minimum wage laws, price controls	
Property rights	Freedom of the judicial system, expropriation, protection of private property	
Regulation	Licensing requirements, labor regulations, corruption	
Informal market	Smuggling, piracy, size of the informal market	
Political rights	Electoral process, pluralism, functionning ofgovernment	Freedom house (2005)
Civil liberties	Freedom of expression, associational rights, rule of law	

APPENDIX 2
Solow Residuals and Cycle Extraction

Country-specific Solow Residuals are derived using the following formula in natural logarithms for the 1960-2005 period:

$$1\text{n}\,(Z_{it}) = 1\text{n}\,(Y_{it}) - (1 - \alpha_i)\,1\text{n}\,(L_{it}) - \alpha_i\,1\text{n}\,(K_{it}) \qquad \text{(A2.1)}$$

where (Z_{it}) is the Solow Residual of country *i* at time *t*; (Y_{it}) corresponds to country-specific GDP at time *t*; (L_{it}) and (K_{it}) correspondingly represent country-specific labor and capital at time *t*. The capital stock is computed using the perpetual inventory method (OECD, 1998), assuming an annual depreciation rate of 4%. Given the absence of reliable data on labor hours for most of the Latin American countries under consideration, Solow Residuals are computed on the basis of total labor force, additionally, the share of labor in total output ($1 - \alpha_i$) is set accordingly to Bernanke and Gürkaynak (2001).

Regarding cycle extraction, we suppose that aggregate variables (country-specific Solow Residuals, GDP, Gross investment), for the 1960-2005 period, can be disaggregated the following way:

$$x_{it} = v_{it} + c_{it} + t_{it} \qquad \text{(A2.2)}$$

where (x_{it}) is the variable of interest in natural logarithms; (v_{it}, c_{it}, t_{it}) correspondingly represent the volatility, the cyclic component and the trend of a series. The trend component is extracted using Hodrick and Prescott's (1980) detrending filter, with a smoothing parameter (λ) equal to 100. The cyclic element of a series is thereafter computed by subtracting the estimated trend component to the original series.

APPENDIX 3
Exploratory Factor Analysis

Exploratory factor analysis is a multivariate statistical technique which aims at explaining the underlying and unobservable structure of a large number of observed variables. Given the information on the interrelations among observed variables, i.e. the correlation matrix, factor analysis derives a set of latent dimensions, known as factors, which explain the measured variables; put differently, exploratory factor analysis expresses the observed variables in terms of unobserved common and specific factors.

The standard model is defined as:

$$x_1 = a_{11}f_1 + a_{12}f_2 + \ldots + a_{1k}f_k + u_1$$

$$x_2 = a_{21}f_1 + a_{22}f_2 + \ldots + a_{2k}f_k + u_2 \quad \text{(A3.1)}$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

$$x_p = a_{p1}f_1 + a_{p2}f_2 + \ldots + a_{pk}f_k + u_p$$

where $x_1, x_2, \ldots x_p$ denote p normalized variables; $f_1, f_2, \ldots, f_k$ represent k common factors ($k << p$); $u_1, u_2, \ldots, u_p$ represent p specific factors and a_{ij} : $\{i = 1,\ldots, p; j = 1,\ldots,k\}$ are the factor loadings. In addition, common factors are standardized [$E(f_j) = 0$; $Var(f_j) = 1$], specific factors have a mean equal to zero and are uncorrelated [$E(u_i) = 0$; $Cov(u_i, u_l) = 0$; $i \neq l$; $i, l = 1,\ldots, p$] and both common and specific factors are independent [$Cov(f_j, u_i) = 0$; $\forall j = 1,\ldots, k$; $i = 1,\ldots, p$].

In matrix notation, we have:

$$X = AF + U \quad \text{(A3.2)}$$

where,

$$X = \begin{bmatrix} x_1 \\ x_2 \\ \cdots\cdots \\ x_p \end{bmatrix}, F = \begin{bmatrix} f_1 \\ f_2 \\ \cdots\cdots \\ f_k \end{bmatrix}, U = \begin{bmatrix} u_1 \\ u_2 \\ \cdots\cdots \\ u_p \end{bmatrix}, A = \begin{bmatrix} a_{11}a_{12}\ldots a_{1k} \\ a_{21}a_{22}\ldots a_{2k} \\ \cdots\cdots\cdots\cdots\cdots\cdots \\ a_{p1}a_{p2}\ldots a_{pk} \end{bmatrix}$$

Once the observed selected variables are standardized and the model is fully characterized, exploratory factor analysis is performed following a six-step procedure:

i. Calculation of the correlation matrix of observed variables
ii. Assessment of the degree of interdependence between observed variables
iii. Factor extraction
iv. Determination of the number of factors
v. Factor rotation
vi. Computation of factor scores

Steps 1 and 2. After computing the sample correlation matrix of variables x_1, x_2, … x_p (the base result from which latent factors are thereafter extracted), it is crucial to determine the statistical significance of the observed interdependencies in order to validate the use of factor analysis. To this matter two widely used measures are the Bartlett's test for sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. The Bartlett's test is derived from a transformation of the determinant associated to the correlation matrix of observed variables; the determinant is then converted to a chi-square statistic and tested for significance under the null hypothesis that the correlation matrix comes from a population in which the variables are noncollinear and that the non-zero correlations are due to sampling errors. The KMO measure is an index (taking values between 0 and 1) for comparing the magnitudes of the correlation coefficients to the magnitudes of the partial correlation coefficients; for values above 0.5 factor analysis is deemed to be appropriate.

Step 3. Factor extraction is based on the previously evoked properties of equation (A3.1) and the so-called fundamental identity of factor analysis, given by:

$$R = AA' + \Omega \quad \text{(A3.3)}$$

where R is the theoretical variance-covariance matrix of observed variables and Ω represents the variance of specific factors. Several extraction methods are employed in order to recover the matrix of unobserved common factors F; in this sense, two main approaches are generally implemented: the maximum likelihood approach and the principal axis factor method (Costello and Osborne, 2005). The maximum likelihood approach estimates the parameters more likely to have generated the observed variance-covariance matrix. This method has two main advantages: first, obtained estimates are invariant to scale and second, the number of retained factors may be selected via hypothesis testing. A major drawback is, however, that convergence may not be attained when observed variables are not normally distributed. The second approach roughly consists in iterating, based on observed sample moments, equation (A3.4) until convergence is attained:

$$\tilde{R} - \tilde{\Omega}^{(w)} = \tilde{A}^{(w)} \tilde{A}^{(w)'} \qquad \text{(A3.4)}$$

where w denotes the number of iterations. This method has the advantage of being consistent even if observed variables are not normal; nevertheless results are scale dependent and statistical inference is not viable.

Step 4. The number of factors is determined by following three generally acknowledged eigenvalue-based procedures: Kaiser's (1960) rule, the Scree test (Cattell, 1966) and the cumulative variance proportion approach. Regarding Kaiser's rule, it consists in calculating the eigenvalues of matrix R and keeping the factors for which eigenvalues are superior to 1. The intuition being that since eigenvalues measure the amount of variance explained by one additional factor, it would not be consistent to consider a factor that accounts for less variance than is contained in one variable. Another approach consists in selecting the number of factors based on the cumulative variance contribution of each unobserved pattern to the overall common factor explained variation; consequently, factors are retained until a minimum cumulative variance proportion (60%-80%) is achieved. The Scree test, on the other hand, relies on a graphic representation of the number of factors (vertical axis) and their associated eigenvalues (horizontal axis). The number of factors is then determined when the plot abruptly levels out.

Step 5. Factors are rotated or rearranged in order to facilitate comprehension and interpretation. The objective is to find a parameterization in which each variable has only a small number of large loadings; that is, each variable is affected by a small number of factors. Once again several rotation methods are available depending on the hypothesized factor correlation structure. If factors are deemed to be uncorrelated, an orthogonal factor rotation should be applied; in contrast, an oblique rotation would be best suited for supposedly correlated factors. In our case, oblique promax rotations are carried out. This approach roughly consists in altering the results of an orthogonal rotation by raising the factor loadings matrix AA' to some power (generally between 2 and 4), until attaining a target matrix, where each factor has only a few high loadings.

Step 6. Factor scores correspond to the estimated values $\hat{F}$, obtained from the empirical approximation of equation (A3.2). In this sense, we follow Bartlett's approach, in which factor scores are derived, by minimizing the sum of the squares of the specific factors, through generalized least squares. Therefore,

$$\hat{F} = \left(A'\Omega^{-1}A\right)^{-1} A'\Omega^{-1}X \tag{A3.5}$$

Factor scores are generally presented in differential format; therefore, a score of 0 corresponds to a factor score equal to the sample mean. In the same way a positive (negative) score is equivalent to a score above (below) the sample mean. An alternative way of expressing factor scores consists in computing their values in levels from the following representation:

$$dfs_{i,t} = \frac{fs_{i,t} - \bar{X}_i}{\bar{X}_i} \Rightarrow fs_{i,t} = \left(1 + dfs_{i,t}\right)\bar{X}_i \tag{A3.6}$$

$dfs_{i,t}$ = factor scores (i) in differential format at time (t)

$fs_{i,t}$ = factor scores (i) in levels at time (t)

$\bar{X}_i$ = average value of the observed outcome indicators associated to factor (i)