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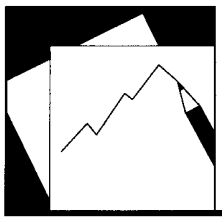

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Revisiting the Determinants of Productivity Growth: What's New?

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Revisiting the Determinants of Productivity Growth: What's new?

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Abstract

This paper studies the main determinants of total factor productivity (TFP) growth using principal component analysis and a dynamic panel data model and, through a case study, explores key areas where accelerated reforms in the Maghreb countries would boost TFP gains. The results reveal that reforms targeted at attracting foreign direct investment and rationalizing government size, shifting resources from low-productivity sectors to higher ones, and encouraging women to enter the work force, could accelerate TFP gains. Equally important are reforms aimed at strengthening human capital, increasing the volume of trade, and improving the business environment.

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I. INTRODUCTION

Recent economic growth literature emphasizes the role of productivity growth as the main driver of long-term per capita growth (Hall and Jones, 1999). A substantial literature has examined the factors explaining cross-country differences in productivity growth. These studies emphasize the key role of macroeconomic and institutional factors, trade openness, and human capital in increasing productivity growth (Edwards, 1997; Barro, 2001; and Acemoglu et al., 2004). But, there is still a considerable debate on the factors that boost productivity growth.

This paper aims to contribute to this debate in several ways. First, we use the principal components analysis (PCA) to overcome the multiplicity of potential determinants of growth. This statistical technique helps identify key combination of policy, human capital, and institutional conditions (layers) associated with high productivity growth. Second, we use a dynamic panel data model to investigate the relationship between productivity growth and several variables that are not frequently used in the existing empirical literature. These include government size, the sectoral composition of output, and the share of women in the labor force. In the remaining of the paper, we refer to those variables as the nontraditional determinants of productivity growth. Finally, we analyze the case of Maghreb countries.

The results show that a large government sector and a high share of value added in agriculture negatively affect productivity growth whereas increasing the share of women in the labor force has a beneficial impact on total factor productivity (TFP) growth. Besides, foreign direct investment does have a positive impact on TFP growth and this impact strongly depends on the domestic workforce's level of education. Macroeconomic stability, greater trade openness, higher stock of human capital and strong institutions are also associated with higher productivity.

The results also indicate that factor accumulation has been the primary driver of growth in the Maghreb region over the period 1970–2005, suggesting that the implementation of productivity-enhancing reforms could be important in boosting output growth in Maghreb countries.

The remainder of this paper is organized as follows. The first section provides a comprehensive analysis of the relationship between productivity growth and several potential determinants using a dataset that includes 62 developed, emerging, and developing countries over the period 1970–2005.[2] In the first step, we explore the relationship using simple correlation and a principal components analysis (PCA) to identify key layers associated with

[2] The authors are grateful to Florence Jaumotte and Nikola Spatafora (Jaumotte and Spatafora, 2007) for providing them with their database. See appendix I for the list of countries, definition of variables, and other details.

high productivity growth. In the second step, we estimate a productivity growth equation using a dynamic panel regression framework. The second section reviews growth performance and the sources of growth in the Maghreb region since the 1970s, and identifies key areas where accelerated reforms in the Maghreb would lead to higher and sustainable growth over the medium and long terms. The third section provides some concluding remarks.

II. REVISITING THE DETERMINANTS OF PRODUCTIVITY GROWTH

The existing empirical and theoretical literature highlights several potential determinants of productivity growth among which inflation, trade openness, the level of education, and several institutional factors. In addition to these traditional factors, we also include other variables barely used, such as foreign direct investment (FDI), the sectoral structure of output, and the share of women in the labor force.

A. The Potential Determinants of Productivity Growth

Macroeconomic factors

Two indicators are used: the rate of inflation and the size of the government.

- **Inflation**: A number of authors have argued that greater macroeconomic instability—in particular, a high inflation rate—tends to affect the economic performance of a country negatively. Hence, we use inflation as a macroeconomic stability indicator.

- **Government size**: The relationship between the size of government, i.e., the ratio of public expenditures to GDP, and productivity growth is ambiguous. Many studies state that government spending has a positive effect on productivity growth because it generates beneficial externalities stemming from several factors, including the development of legal and administrative institutions, the development of economic infrastructures, and multiple interventions to correct market failures (Ghali, 1998). Indeed, it is fully recognized that some government spending, particularly on public goods, is necessary to promote productivity growth. However, excessively large government spending can hinder productivity growth because of government inefficiencies, the burden of taxation, and distortions provoked by interventions to free markets (Barro, 1991; Atul A. Dar, Sal Amir Khalkhali, 2002). Thus, it is not clear whether the overall impact of government size on productivity growth is positive or negative, and whether that relationship is monotonic. However, most empirical studies present strong evidence that a large and growing government is not conducive to higher productivity growth or better economic performance.

Trade openness and knowledge spillovers

- **Trade openness**: Grossman and Helpman (1991) and Barro, Sala-i-Martin (1995), and Edwards (1997) among others, have argued that countries that are more open have a greater ability to benefit from technology diffusion and its boosting effect on productivity growth. Dollar and Kraay (2004) also find evidence that greater openness to trade can generate economies of scale and productivity gains. However, there has been an increasing recognition in recent years of the importance of complementary policies in enhancing the benefits of a more open trade regime. Such policies include sound macroeconomic policies, market supporting institutions, good infrastructures, appropriate business regulations, well functioning credit markets, and flexible labor markets (Chang, Kaltani, and Loayza, 2005). We use the ratio of imports plus exports to total GDP as a proxy for trade openness. However, this indicator can introduce a bias, particularly for countries whose trade flows are dominated by natural resources such as oil. To account for this bias, we also use two alternative indicators: the degree of trade openness at the beginning of the sample period, and the fraction of the sample period in which the country has been considered open according to the Welch-Wacziarg (2003) index.

- **FDI**: According to the theoretical literature, FDI stimulates economic growth by improving technology and productivity (Borensztein et al., 1998). Host economies are expected to benefit from the positive externalities fueled by FDI. Those include knowledge spillovers generated by technology transfers, introduction of new processes and managerial skills, and know-how diffusion to the domestic market. However, Alfaro et al. (2009) suggests that the overall impact of FDI on productivity is somewhat mixed.[3] The majority of these studies find that the impact of FDI on productivity and growth depend on other factors, such as the level of human capital (Borensztein et al., 1998) and the development of the domestic financial market (Alfaro et al., 2003). To some extent, the level of FDI also reflects the macroeconomic environment of a country: countries with low inflation, appropriate macroeconomic fiscal and exchange rate policies are expected to attract more FDI. Such an environment is expected to be also conducive of higher productivity growth. We use the ratio of FDI to GDP.

Labor quality

Labor quality is an important factor of economic growth (Barro, 2001). The impact of labor quality on economic growth is of two orders: a direct impact by improving the effectiveness of the labor used for production and an indirect one through productivity growth. As discussed earlier, a country with higher labor quality is more able to benefit from positive

[3] Alvaro et al., (2009) find evidence that factor accumulation (physical and human capital) does not seem to be the main channel through which countries benefit from FDI. Countries with well-developed financial markets gain significantly from FDI via TFP improvements.

externalities generated by openness and FDI. It is then expected that improvements in labor quality would be associated with higher productivity growth. In our study, we use the average schooling years from Barro and Lee (2000) and the ratio of labor input to the number of hours worked from Jorgenson and Vu (2005) as proxies for labor quality.

Institutional factors

Recent empirical studies highlight the importance of good institutions to promote productivity and long-term growth (Acemoglu et al., 2004). Efficient institutions enhance the business environment and, hence, boost investment and productivity. We explore the link between productivity and several institutional indicators measuring government effectiveness, economic freedom, rule of law, and regulatory burden.

Sectoral composition of output

A number of empirical studies have found that a transition of economic activity from agriculture to nonagricultural sectors would lead to stronger productivity growth, as it implies a shift from lower- to higher-productivity sectors (Poirson, 2000; Jaumotte and Spatafora, 2007). These studies also found that countries with a higher value-added share of high-productivity growth sectors also have higher aggregate productivity growth. We use the share of agricultural value added to overall GDP to measure this effect.

Female labor participation

The promotion of women's education and the integration of women into the labor force may increase productivity and growth. In development economics, it is now fully acknowledged that educated women allocate a higher share of households' resources to education and healthcare—two factors that are expected to boost productivity and growth in the long-run. A few studies have attempted to examine the impact of increased female participation on productivity growth in advanced economies.[4] These studies provide mixed empirical evidence about the importance of female labor participation for productivity growth. McGuckin and Van Ark (2005) find that higher female participation may lead to productivity losses when the new entrants are older women reintegrating into the work force on a part-time basis and after a period of inactivity. However, these effects are likely to disappear over time. De Jong and Tsiachristas (2008) argue that higher female participation may lead to productivity growth if workers can adapt to innovations.

[4] We are not aware of such studies on developing countries. Papers on developing countries have mainly focused on analyzing the impact of increasing women's capabilities and access to resources on growth and agricultural output (Udry et al., 1995; Seguino, 2008).

B. Key Layers for Productivity Growth and Top Emerging Economies

We use cross-correlations between variables, cross-country plots, and principal component analysis (PCA)[5] to show simple association between TFP growth[6] and identify potential combinations of policy, human capital and institutional factors that are associated with high productivity. The analysis uses one observation—representing the average over the period 1985–2005—for each country. Table A1 provides a list of the variables we use and their definition.

The cross-correlations between variables (Table A2.1) and cross-country plots (Figure A3.1) confirm most of the findings in the literature. Inflation matters: high TFP growth is generally associated with low inflation. A high level of FDI and human capital, a high level of female labor participation, greater trade openness, and better institutions and business regulation are usually associated with high TFP growth. We also found a relatively high negative correlation between productivity growth and the share of agricultural value added to overall GDP.

The PCA extracts four principal components, representing about 79 percent of the total variance (Table A2.2 and Figure A3.3). The first component captures mostly positive co-variations between TFP growth, the share of services to GDP, the share of FDI to GDP, and labor quality, and negative co-movements between these variables and the share of value added in agriculture to GDP. Most of the variation in the second component comes from changes in both indicators of openness and the degree of regulation in credit, labor, and business. The third and fourth components, respectively, weigh most strongly female labor participation and inflation, suggesting that these two variables move almost independently of the other variables. For the sake of simplicity and clarity, we will name the first component: "attractive business environment", the second: "openness and strong institutions", the third: "female labor participation", and the fourth: "macroeconomic stability".[7] These components represent the four main layers of productivity growth.

Analyzing the performance of countries with respect to these four layers of productivity growth, three countries emerge as top performers: Chile, Malaysia, and Thailand

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[5] The PCA is a mathematical procedure that reduces the dimension of a dataset by synthesizing the information contained in a number of possibly correlated variables into a smaller or equal number of uncorrelated variables named principal components. Each component is interpreted using the contributions of variables to the component (Pearson, 1901 and Jolliffe, 2002).

[6] See appendix I for details of TFP growth (sources of data, definition, and calculation).

[7] The procedure is applied to 10 variables: the TFP growth, the levels of inflation, the ratio of FDI to GDP, and labor quality, the ratio of private credit to GDP, the share of agriculture and services to GDP, the ratio of trade flows to GDP, the degree of openness at the beginning of the period, female labor participation, and the degree of regulation in credit, labor, and business.

(Figure A3.2). These top performers do well in all areas: they exhibit an attractive business environment, wide trade openness, strong institutions, relatively high female participation in the labor force, and macroeconomic stability. The three top performers enjoy high productivity growth, far above the World average (Figure A3.4).

C. Productivity Equation

This section estimates a productivity equation using panel data procedures. For this analysis, we use a sample of unbalanced panel dataset of 62 countries with at most six observations per country representing nonoverlapping 5-year averages over the period 1970–2005. We model TFP growth as a function of several determinants including the initial income per capita—to capture conditional convergence, economic policy factors, human capital factors, the share of value added in agriculture to total output, and some indicators of institutional quality. The regression equation is the following:

$$PD_{i,t} = \alpha + \rho PD_{1,t-1} + \beta y_{i,1} + \gamma Inf_{,i,t} + \phi Open_{i,t} + \lambda HK_{i,t} + \kappa Govt_{i,t} + \delta Inst_{i,t} + \eta SR_{i,t} + \varphi FDI_{i,t} + \mu_i + v_t + e_{i,t}$$

where PD represents the productivity growth; *y*, the initial income per capita; Inf, the average inflation; Open, the trade openness indicators; *HK*, the level of education; *Govt*, an indicator of government size; *Inst*, the indicators of institutional quality; *SR*, structural factors including the share of value added in agriculture to total output and female labor participation; FDI, the ratio of FDI to GDP; μ_i, a country-specific effect; v_t, a time-specific effect; and $e_{i,t}$, the common error term. For each indicator, *i* represents the country and *t* the period.

Estimation

We estimate the equation using the system GMM (Generalized Method of Moments) dynamic panel estimator (Blundell and Bond, 1998). This method jointly estimates the equation in levels and in first difference, imposing the restriction that the coefficients in the level and differenced equation are equal. The instruments used in the level equation are the lagged first-differences of the variables. The GMM-type instruments for the differenced equation are the lagged levels of the variables. The equation in levels allows one to exploit the large cross-country variation in the variables, whereas in the differenced equation, time-invariant, country-specific, sources of heterogeneity are removed. In addition, the use of appropriate lags of right-hand side variables as instruments allows one to address problems of measurement errors, omitted variables and endogeneity (Dollar and Kraay, 2001). To ensure that our results are not driven by time-specific effects, we incorporate a dummy

variable for each period in all regressions. The validity of the GMM instruments is tested using the Hansen-J statistic of over-identifying restrictions.[8]

Results

The results confirm that macroeconomic policy, human capital, institutional and socio-economic factors are all critical for boosting productivity growth.

Macroeconomic stability, openness and the level of education are important for productivity growth. Our basic specification (Table A2.3, column 1) explains productivity growth as a result of the initial level of per capita GDP, inflation, trade openness, and the level of education. In line with previous findings, trade openness and the initial level of education appear to have positive and significant effects on productivity growth while higher inflation hampers significantly productivity gains, confirming the negative impact of macroeconomic instability. The results are similar when using simple OLS, a static panel regression, or a simple dynamic panel regression (i.e., without system GMM). In each regression, the coefficients of inflation, trade openness, and initial education have the expected signs. Besides, the coefficients of inflation are always strongly statistically significant and those on initial education and trade openness are significant in most of the regressions (Table A2.4).

Government size does matter for productivity growth. The coefficient of government size is negative and statistically significant suggesting that, overall, large government would result in lower productivity growth (Table A2.6, column 2).

Strong institutions also matter for productivity growth. We use three alternative indicators: the degree of regulation of credit, labor, and business; law of order; and the economic freedom index. The results show that strong institutions are important for achieving high TFP growth. The coefficients of two out of the three indicators (the economic freedom index, the degree of regulation of credit, labor, and business) are positive and significant (Table A2.3, columns 3 and 4).

Reducing the predominance of the agricultural sector would lead to higher productivity growth in developing and emerging countries. Introduced alone in the basic regression, the coefficient of the share of value added in agriculture is surprisingly positive and statistically significant (Table A2.3, column 5), suggesting that countries with a high share of valued added in agriculture tend to have higher productivity growth. This finding raises an interesting question: does the positive impact hold across the sample? In other words, does a higher share of valued added in agriculture drive up productivity gains in all countries? To allow for effects contingent on the level of development of countries, we introduce an

[8] The Sargan test is not reported because studies show that when applied to a system GMM, the test is undersized, i.e., it rejects the null hypothesis of no over identifying restrictions more often than it should when H_0 is true and can have a very low power, rejecting H_0 rarely when it is false.

interaction term, the share of value added in agriculture times a dummy variable for advanced economies. The results (Table A2.3, column 6) show, as expected, that a higher share of value added in agriculture is indeed associated with lower productivity growth in developing and emerging countries and higher one in advanced economies.

Increasing female labor participation boosts productivity growth. The coefficient of the share of women in the labor force is positive and statistically significant; suggesting that stepping up female labor participation enhances productivity growth.

FDI help productivity gains. Adding the ratio of FDI to GDP to the basic regression (Table A2.3, column 7) show that FDI has a significant positive impact on TFP growth.[9] To further understand how these productivity gains take place, we include interaction terms to capture possible complementarities between FDI and other determinants. The results (Table A2.3, column 8) show that the coefficient of the interaction between FDI and the level of education is positive and significant: the higher the level of human capital, the better a country can benefit from positive spillovers from FDI to accelerate its TFP growth. In other words, highly skilled-domestic workforce is more able to benefit from transfer of new technology through FDI than low-skilled one. These results confirm that the impact of FDI on TFP growth critically depends on the absorptive capacity of the local economy.

III. GROWTH PERFORMANCE: HOW DO THE MAGHREB COUNTRIES COMPARE TO THE OTHER ECONOMIES?

This section analyzes several aspects of Maghreb's growth performance since the 1970s (Algeria, Morocco, and Tunisia).[10] It first provides some stylized facts about growth performance in Algeria, Morocco and Tunisia. Then it analyzes the sources of growth in the Maghreb over 1970–2005 using a standard growth accounting framework. In both subsections, comparisons with selected Asian and Middle Eastern emerging economies are made. To end, the section draws some lessons from the three top performing emerging countries (Chile, Malaysia, and Thailand) and identifies key areas where accelerated reforms could boost Maghreb productivity growth.

A. Some Stylized Facts

Growth performance in Algeria, Morocco, and Tunisia over 1970–2005 was somewhat mixed (Tables A2.5 and A2.6). On average, real GDP growth was higher in the region than in Latin and Central America and in other Middle Eastern countries, but fell short of rates in

[9] It should be noted that the inclusion of FDI to GDP drops the number of observations from 344 to 209, mainly because these data were not available for many countries during the first periods.

[10] Mauritania and Libya, the two other Maghreb countries, are not included in the study because of lack of data.

Asian emerging economies. However, this global picture hides interesting developments over the period and across countries.

The Maghreb region experienced relatively rapid growth during the 1970s. Real GDP growth ranged from 5.5 percent in Algeria to 7.6 percent in Tunisia and averaged 6.3 percent for the region—a rate comparable to that of emerging Asian economies.

The picture turned gloomy during the 1980s and 1990s, in particular for Algeria and Morocco. Algeria witnessed negative real GDP per capita growth for both periods, resulting mainly from the decline in world hydrocarbon prices, slow and hesitant reforms, and civil unrest. During the same period, Morocco also experienced a hard—albeit less severe than in Algeria—economic downturn due to several consecutive droughts. Unlike its neighbors, Tunisia recovered rapidly in the 1990s—after experiencing a decline in growth by more than three-fourth in the 1980s—thanks to prudent macroeconomic policies and relatively deep integration into the world economy.

On a more positive note, growth in all three countries has accelerated since 2000. Macroeconomic and structural reforms in these countries have resulted in more outward-oriented and liberalized economies and have laid the groundwork for a growth recovery, with average real GDP growth exceeding 4 percent since 2000. Yet, growth figures remain below the 1970s average and below the performance of other emerging economies.

B. Growth Profile

A standard growth accounting framework is used to identify the sources of growth in the Maghreb and other selected emerging economies over the period 1970–2005. The procedure decomposes changes in output into three components: the contributions of input factors—physical and human capital—and a residual, which represents the contribution of TFP to overall growth. The results suggest that, over the 25-year period, GDP growth in the Maghreb—as well as in other regions—was essentially attributable to factor accumulation (Table A2.7). On average, in all countries except the Asian emerging economies, real output per worker growth benefited from growth in physical and human capital while being dampened by productivity losses. However, the Maghreb countries experienced the largest decline in productivity and the lowest physical capital accumulation during the period, resulting in the current GDP gap between them and the other countries, especially Asian emerging countries.

In all regions, the relative importance of the contribution of TFP growth over the years appears to be important for output growth acceleration. While positive TFP growth contributed to rapid growth in the 1970s, the downturn experienced during the 1980s and 1990s was almost entirely due to a steep decline in productivity. In addition, the recovery witnessed since the 1990s is associated with an increase in productivity growth and a return to positive contributions in the 2000s. In the Maghreb, TFP growth remained relatively low compared to the other regions, and improvements in human capital remained the main

channel of real output-per-worker growth, while in the Asian emerging economies, TFP growth took a leading role.

Intra-Maghreb analysis reveals differencing growth paths. Tunisia enjoyed the highest real GDP per worker growth but also the highest TFP and physical capital contributions to growth in the region during the entire period. In addition, unlike in Algeria and Morocco, growth in Tunisia was mainly driven by TFP, except lately, as human capital accumulation started to take over. The significant slowdown in the Algerian growth rate in the 1980s and the 1990s was almost entirely attributable to negative productivity growth and a sharp decline in the contribution of capital stock. This was followed by a modest recovery in output per worker and TFP during 2000–05. But, the contribution of human capital was still larger than those of productivity and physical capital, the latter remaining negative. Morocco's growth pattern was quite different. There, growth was alternatively driven by physical and human capital accumulation over the years, with a recent predominance of physical capital. However, since 2000, rising TFP growth and faster physical capital accumulation led to a strong economic performance.

C. Boosting Productivity in Maghreb: Lessons from Top Performing Emerging Economies

Overall, the Maghreb countries have made significant progress toward macroeconomic stability. Macroeconomic reforms, including prudent fiscal and monetary policies have helped keep inflation in the Maghreb region relatively close to the level observed in the three top performers. Algeria, Morocco, and Tunisia have also made some progress in the institutional and structural areas:

- External trade has been liberalized, but more needs to be done to close the gap with the three top performers. In line with worldwide trends, bilateral and regional trade agreements have proliferated in the Maghreb region, including the Association Agreements with the European Union. Furthermore, the Maghreb countries have demonstrated strong progress over the last few years in lowering tariff barriers. However, the latter remains relatively high, suggesting that there is still room for progress in this area to further liberalize trade and foster productivity.

- Foreign direct investments have increased in recent years, but remain relatively low when compared with the three top performers. Attracting more FDI would help increase productivity.

- Important progress on human development has also been registered. The health situation has improved, and the enrollment rate in primary education is near to 100 percent in most of the countries. However, human capital development still lags behind and closing the gap with three top performers on this area would help improve productivity in the region.

- The business environment has improved significantly (Tahari and Loko, 2007) but more is needed.[11] Policy reforms are being implemented to improve institutions and governance, reduce the cost of doing business, and promote private sector activity. However, most reforms in a number of regulatory areas have been implemented from the mid-1990s onwards while other emerging economies, and in particular the identified three top performers have started earlier and have been moving faster. The World Bank Overall Ease of Doing Business and Governance Indicators, and the Global Competitiveness Report indicators show that Maghreb countries, and in particular Algeria, still continues to suffer from significant impediments to conducting business (Table A2.8). For instance, as shown by the World Bank *Government Effectiveness* indicator (measuring the competence of the bureaucracy and the quality of public service), Algeria is still in the low range of countries suffering from inefficient bureaucracy and red tape.

Despite these improvements, the three Maghreb countries, particularly Algeria and Morocco, are still lagging behind in terms of institutional and structural reforms (Figure A3.2 and A3.4, and Table A2.9) and would need to step up efforts to close the gap with Chile, Malaysia, and Thailand. In particular, reforms aimed at boosting the volume of trade and the level of FDI, reducing the predominance of agriculture in the country economy, improving the business environment and labor quality, and attracting women into the active population could increase productivity in the Maghreb countries.

IV. CONCLUSION

This empirical study seeks to contribute to the ongoing debate on the factors that boost productivity growth. To do so, we include in our specification a number of variables that are not frequently used in the literature. These include the size of the government, the sectoral decomposition of output and female involvement in the labor market. We also use the principal component analysis to overcome the multiplicity of potential determinants of growth. This statistical technique helps identify key combination of macroeconomic policies, human capital, socio-economic and institutional conditions (layers) associated with high-productivity growth.

Our results confirm the key role of macroeconomic and institutional factors, trade openness, and human capital in increasing productivity growth. In addition, our findings suggest that

[11] A number of indicators are available to assess the quality of a country's investment climate and good governance including the Global Competitiveness Report, the International Country Risk Guide, the World Bank Investment Climate Surveys, the World Bank Public Governance indicators, and the World Bank Doing Business Indicators. Notwithstanding their limitations, such indicators can be of some help to (a) track the position of the country vis-à-vis competitors and know how the country is seen in a global context; (b) understand the relative strengths and weaknesses of a country's investment climate as seen by both local and foreign investors; and (c) assess the effectiveness of policy initiatives in improving the investment climate.

reforms targeted at attracting more foreign direct investment and rationalizing government size, shifting resources from low-productivity sectors to higher ones, and encouraging women to enter the work force, could accelerate TFP gains, in particular in less-advanced economies. Overall, achieving high-productivity growth requires a certain combination of good macroeconomic environment, trade openness and strong institutions, development of human capital, and institutional and socio-economic factors that promote an attractive business environment.

The economic reforms undertaken by the three Maghreb countries (Algeria, Morocco, and Tunisia) in recent years have generally contributed to macroeconomic stability and increasing growth. Average real GDP per capita growth reached 3.2 percent in 2000–06, from 1.3 percent in 1990–99, helping these countries reduce poverty rates and raise living standards. But this performance is relatively modest, and the three countries need to increase growth significantly on a sustained basis to further reduce unemployment and poverty, and narrow the gap that separates them from the more dynamic emerging market economies, especially emerging Asian ones. A comparison of Maghreb countries with top emerging market performers shows that in Algeria and Morocco much remains to be done in most of structural and institutional reform areas (outside of reducing inflation).Tunisia is in a better position, but still needs improvement, particularly with respect to increasing the number of women in the labor population. Sound macroeconomic policies, transfer of technology and knowledge through international trade and FDI, human capital with high standards, sectoral output composition, and good institutional environment are important for boosting productivity.

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Appendix I: List and definition of variables

We use the database from Jaumotte and Spatafora (2007). All data are in logarithmic form except indexes.[12] Below is the table of variables with their definitions.

Table A1. List and definition of variables

Variables	Names	Definitions
Variables in the regressions		
Productivity	gTFP	Total factor productivity
Initial income per capita	lypc_ini	Output per capita; level at the beginning of each period
Inflation	dlcpi_weo	Variations of WEO consummer price indexes
Trade openness	openstart1	Degree of openness in 1985
Initial education	ledu15_ini	Average schooling years from Barro and Lee (2000); level at the beginning of each period
Government size	lgovt_sze	Based on the ratio of public expenditures to GDP (http://www.heritage.org/Index/FAQ.aspx)
Initial degree of regulation	reg_lab_ini	Regulation of credit, labor, and business; level at the beginning of each period
Economic freedom index	tot_ci	Economic freedom index (http://www.heritage.org/Index/Ranking.aspx)
Share of value added in agriculture	lagrvash	Ratio of the value added in agriculture to total GDP
Initial Female labor paticipation	lfemlaborpop_ini	Share of women in the labor force (from WDI); level at the beginning of each period
FDI to GDP	lfdi_weo	Ratio of FDI to GDP
Other variables		
Share of value added in services	lservvash	Ratio of the value added in services to total GDP
Trade flows to GDP	ltradeopen	Exports plus imports over GDP
Trade openness	open_ww	Fraction of the sample period in which a country is considered open according to the Wacziarg and Welch (2003) indicator; level at the beginning of each period
Labor quality	ln_lbquality	Ratio of labor input to the number of hours worked from Jorgenson and Vu (2005)
Credit to the private sector	pcrdbgdp_levine	Private credit to GDP of development banks

A standard growth accounting framework is used by the authors to identify the sources of growth in countries. The production process (Y) is assumed to be characterized by a conventional Cobb-Douglas technology, which utilizes the stock of physical capital (K), the stock of human capital (H), and labor employed (L), as well as TFP (A). The share of capital in total national income, α, is assumed to be one-third, following the standard practice in the literature. The growth of output per worker is decomposed into the contributions of TFP growth, physical capital, and human capital. The findings must be interpreted with caution because TFP is calculated as a residual and it may not only capture the effects of technical change but also other factors to the extent that they are not accounted for by their effects on increases in factor inputs.

The database includes 62 countries: Algeria, Argentina, Austria, Bangladesh, Belgium, Bolivia, Brazil, Cameroon, Chile, China, Colombia, Costa Rica, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Finland, France, Germany, Ghana, Greece, Guatemala, Honduras, India, Indonesia, Iran (I.R. of), Ireland, Italy, Jordan, Kenya, Luxembourg, Madagascar, Malawi, Malaysia, Mali, Mauritius, Mexico, Morocco, Netherlands, Nicaragua, Nigeria, Pakistan, Paraguay, Peru, Philippines, Portugal, Rwanda, Senegal, South Africa, Spain, Sri Lanka, Sweden, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Kingdom, Uruguay, Venezuela (Rep. Bol.), and Zambia.

[12] The variables reg_lab_ini, openstart1, and pcrdbgdp_levine are not in logarithm terms.

Appendix II: Tables

Table A2.1. Correlations between selected variables, 1985–2005

	gtfp100	dlcpi	ltradeopen	lfdi	lagrvash	reg_lab	tot_ci	ln_lbquality	lfemlaborpop
gtfp100	1								
dlcpi	-0.4196	1							
ltradeopen	0.3081	-0.6654	1						
lfdi	0.4664	-0.0896	0.0801	1					
lagrvash	-0.5674	0.2075	-0.1777	-0.8006	1				
reg_lab	0.5341	-0.2592	0.3657	0.4639	-0.4814	1			
tot_ci	0.6789	-0.4847	0.5676	0.5448	-0.6726	0.8164	1		
ln_lbquality	0.7294	-0.3277	0.3327	0.6751	-0.8851	0.704	0.8392	1	
lfemlaborpop	0.4102	0.0186	0.1684	0.4123	-0.5319	0.534	0.6159	0.5829	1

Source: Authors' calculations.

Table A2.2a. Variance captured by components

Component	Variance	Difference	Proportion	Cumulative
Comp1	4.612	2.958	0.419	0.419
Comp2	1.654	0.447	0.150	0.570
Comp3	1.206	0.035	0.110	0.679
Comp4	1.172	…	0.107	0.786

Source: Authors' calculations.

Table A2.2b. Loadings of variables on components

Variable	Comp1	Comp2	Comp3	Comp4	Unexplained
gTFP	0.207	0.033	0.342	-0.266	0.384
dlcpi	-0.019	-0.083	0.005	0.795	0.162
lfdi	0.460	-0.138	-0.161	0.046	0.217
ltradeopen	-0.138	0.701	-0.152	-0.231	0.190
pcrdbgdp_levine	0.359	0.081	-0.002	-0.232	0.170
openstart1	0.176	0.463	0.066	0.389	0.307
ln_lbquality	0.402	0.106	0.071	-0.005	0.067
lagrvash	-0.469	0.108	0.024	0.038	0.108
lservvash	0.404	-0.055	-0.093	0.070	0.348
reg_lab	0.144	0.482	0.139	0.171	0.309
lfemlaborpop	-0.032	-0.043	0.892	0.017	0.095

Source: Authors' calculations.

Table A2.3. Determinants of productivity growth, 1970–2005

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Initial income per capita	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Inflation	-0.018***	-0.017***	-0.012***	-0.011***	-0.016***	-0.015***	-0.015***	-0.010**
	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)
Trade openness	0.011***	0.009***	0.007*	0.007*	0.011***	0.008**	0.008*	0.007*
	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.005)	(0.004)
Initial education	0.005*	0.003	0.001	-0.000	0.007*	0.007*	0.005*	0.005
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)	(0.005)
Government size		-0.011***	-0.016***	-0.015***	-0.014***	-0.0104**	-0.012**	-0.014**
		(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Economic freedom index			0.004**					
			(0.002)					
Initial degree of regulation				0.007***				
				(0.002)				
Share of valued added in agriculture					0.004*	0.013***		
					(0.002)	(0.004)		
Share of VA in agriculture*Non advanced						-0.008***		
						(0.003)		
Initial Female labor paticipation							0.034*	
							(0.019)	
FDI to GDP								-0.005
								(0.003)
FDI*initial education								0.004**
								(0.002)
Constant	0.002	0.019	0.009	0.004	0.008	-0.0004	-0.1	0.018
	(0.007)	(0.010)	(0.011)	(0.013)	(0.012)	(0.012)	(0.072)	(0.013)
Nb. observations	324	323	313	302	317	317	273	215
Nb. countries	56	56	56	56	55	55	56	54
Hansen test	52.4	50.4	46.6	49.9	47.3	47.3	47.3	39.9
	(0.307)	(0.341)	(0.573)	(0.986)	(0.544)	(0.544)	(0.842)	(1.000)

Source: Authors' calculations.

Notes: The dependent variable is total factor productivity growth.

All regressions include period-dummy variables (only the significant one are kept).

"*", "**", and "***" refers respectively to significance at 10 percent, 5 percent, and 1 percent.

Table A2.4. Common determinants of productivity growth using diverses estimation methods, 1970–2005

	OLS	BE	FE	RE	Abond	Abond2steps
Initial income per capita	-0.001*	-0.001	-0.023***	-0.001	-0.047***	-0.052***
	(0.000)	(0.001)	(0.007)	(0.001)	(0.013)	(0.017)
Inflation	-0.015***	-0.015*	-0.017***	-0.015***	-0.016***	-0.016***
	(0.003)	(0.008)	(0.003)	(0.002)	(0.004)	(0.005)
Trade openness	0.012***	0.020***	0.005	0.008***	0.005	0.009
	(0.003)	(0.005)	(0.004)	(0.003)	(0.005)	(0.007)
Initial education	0.004*	0.002	0.012	0.004	0.027**	0.014
	(0.002)	(0.003)	(0.009)	(0.003)	(0.013)	(0.015)
Constant	0.000	0.011	0.203	0.003	0.417	0.483**
	(0.006)	(0.011)	(0.063)	(0.008)	(0.116)	(0.158)
Nb. observations	377	377	377	377	268	268
Nb. countries	…	56	56	56	56	56

Source: Authors' calculations

Notes:
The results display robust standard errors into brackets.
"*", "**", and "***" refers respectively to significance at 10 percent, 5 percent, and 1 percent.
OLS refers to the pooled regression.
OLS, BE, and RE regressions incorporate time dummies.
The Hausmann tests using the between regression, the fixed effects, and the random effects conclude that random effects are not suitable for this model.
Both Arellano-Bond estimations (one step and two-steps) pass the diaganostic tests: no overidentified restrictions and one-order autocorrelation exists but not two-order one.

Table A2.5. Real GDP growth, 1970–2005

	1970–79	1980–89	1990–99	2000–06	1970–2006
Algeria	5.5	2.3	1.6	4.1	3.3
Morocco	5.7	3.9	2.8	4.9	4.3
Tunisia	7.6	3.6	5.0	4.6	5.3
By region					
Maghreb	6.3	3.3	3.1	4.6	4.3
Other MENA emerging	4.8	4.9	4.1	5.2	4.7
Asian emerging	6.3	5.3	5.1	5.4	5.5
Memo items					
Central America	5.0	1.3	4.1	3.8	3.5
Latin America	5.3	1.5	3.4	3.8	3.5
SSA	3.6	2.6	3.0	4.4	3.3
EU	3.7	2.5	2.8	2.7	3.0

Source: Authors' calculations.

Notes: Asian emerging countries: India, Indonesia, Malaysia, Philippines, Thailand.
Other Mena countries: Egypt, Jordan, Pakistan, and Turkey.

Table A2.6. Growth in real GDP per capita, 1970–2005

	1970–79	1980–89	1990–99	2000–06	1970–2006
Algeria	2.3	-0.9	-0.4	2.3	0.7
Morocco	2.8	1.4	1.2	3.7	2.2
Tunisia	5.3	1.2	3.1	3.6	3.3
By region					
Maghreb	3.5	0.6	1.3	3.2	2.1
Other MENA emerging	2.3	2.0	1.4	3.1	2.1
Asian emerging	3.7	3.0	3.1	3.7	3.3
Memo items					
Central America	2.0	-0.8	1.7	1.5	1.1
Latin America	3.0	-0.5	1.6	2.6	1.7
SSA	0.9	-0.2	0.5	1.8	0.7
EU	3.2	2.2	2.3	2.1	2.4

Source: Authors' calculations

Notes: Asian emerging countries: India, Indonesia, Malaysia, Philippines, Thailand.
Other Mena countries: Egypt, Jordan, Pakistan, and Turkey.

Table A2.7. Growth accounting, 1970–2005

	1970–79	1980–89	1990–99	2000–05	1970–2005
			Ouput per worker		
Algeria	3.3	-1.4	-2.8	0.6	-0.1
Morocco	1.9	0.6	-0.6	1.7	0.9
Tunisia	3.9	0.7	1.8	1.6	2.0
By region					
Maghreb	3.1	-0.1	-0.5	1.3	0.9
Other MENA	3.1	0.8	1.0	1.7	1.6
Asian emerging	3.1	2.5	2.7	2.7	2.7
			TFP growth		
Algeria	0.2	-3.2	-2.7	0.1	-1.4
Morocco	-1.0	-0.8	-1.6	0.2	-0.8
Tunisia	1.9	-0.8	0.8	0.5	0.6
By region					
Maghreb	0.4	-1.6	-1.2	0.3	-0.5
Other MENA	-0.3	-1.1	-0.4	0.7	-0.3
Asian emerging	0.3	0.1	-0.1	1.4	0.4
			Capital		
Algeria	1.7	0.3	-1.4	-0.6	0.0
Morocco	1.8	0.5	0.1	0.8	0.8
Tunisia	1.1	0.6	0.3	0.4	0.6
By region					
Maghreb	1.5	0.5	-1.3	0.2	0.5
Other MENA	2.3	0.8	0.5	0.1	0.9
Asian emerging	1.8	1.5	1.9	0.6	1.4
			Human capital		
Algeria	1.6	1.5	1.3	1.1	1.3
Morocco	1.1	0.9	0.8	0.7	0.9
Tunisia	0.9	0.8	0.8	0.7	0.8
By region					
Maghreb	1.2	1.1	1.0	0.9	1.0
Other MENA	1.1	1.1	0.9	0.8	1.0
Asian emerging	1.1	0.9	0.8	0.7	0.9

Source: Authors' calculations

Notes: Asian emerging countries: India, Indonesia, Malaysia, Philippines, Thailand.
Other Mena countries: Egypt, Jordan, Pakistan, and Turkey.

Table A2.8. Some Doing business and governance indicators

	GCR rank 1/	WB DB rank 2/	Government effectiveness 3/	Regulatory quality 3/	Control of corruption 3/	Rule of law 3/
Algeria	99	132	36	26	41	26
Morocco	73	128	55	51	53	51
Tunisia	36	73	69	57	60	60
Chile	28	40	86	91	90	88
Malaysia	21	20	83	67	62	65
Thailand	34	13	62	56	44	53

Source and notes:

1/ Global competitiveness report 2008–09. Rank out of 134 countries.

2/ World bank Doing Business 2009 report. Rank out of 181 counties.

3/ percentile rank, 2007. Total of 212 countries.

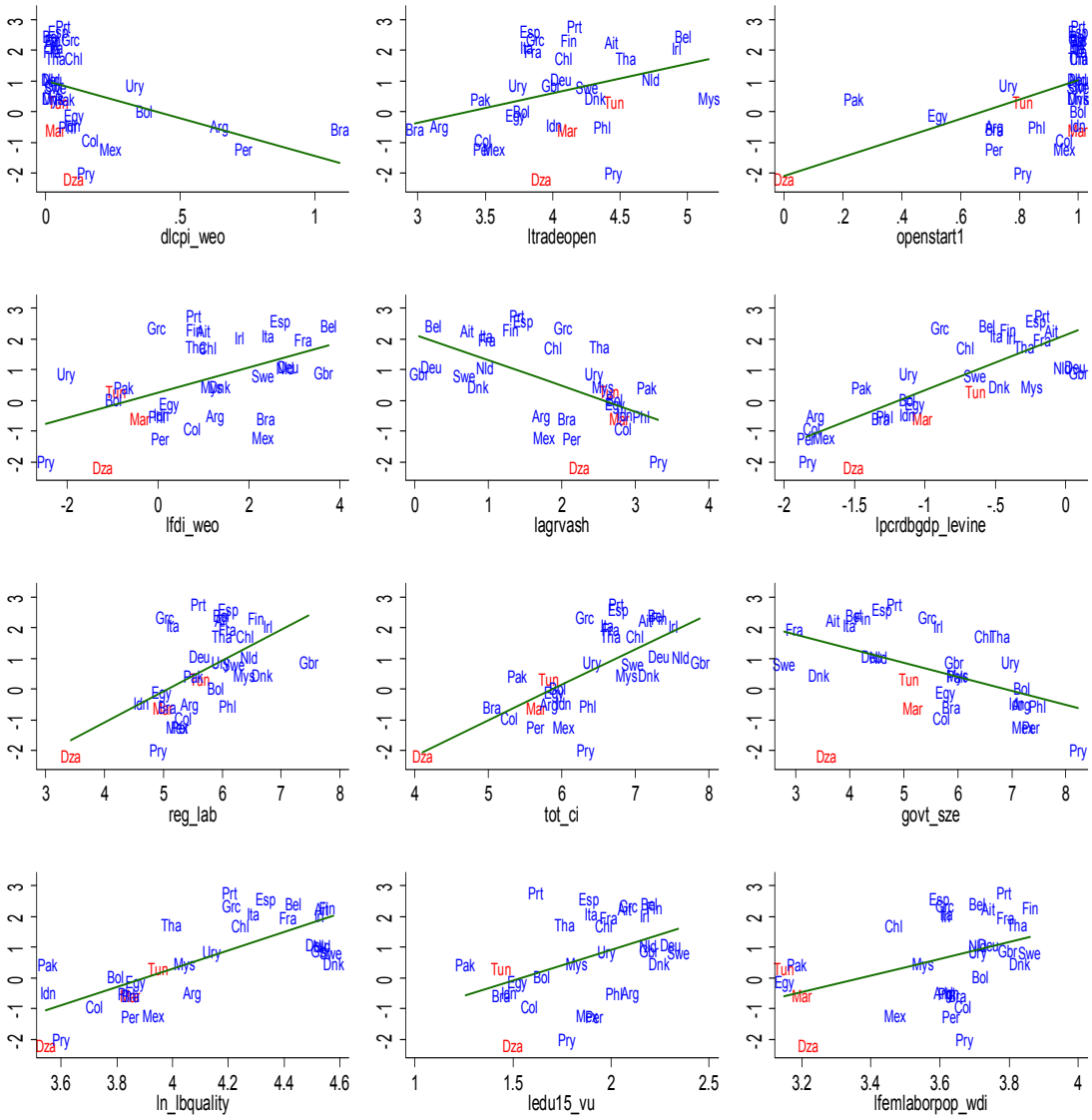
Table A2.9. Mean of the main determinants of TFP growth for a selected group of countries, 1985–2005

	gtfp (‰)	dlcpi (%)	fdi	agrvash	tradeopen	lbquality	reg_lab	femlaborpop (%)	govt size
Top 3 performers	13.08	5.52	2.83	10.52	109.08	60.27	6.25	37.51	6.41
DZA	-21.76	10.31	0.29	9.33	50.06	34.65	3.42	25.01	3.57
MAR	-5.95	3.63	0.67	16.13	60.81	46.95	4.99	24.53	5.17
TUN	3.04	4.70	0.40	14.03	85.93	51.84	5.62	23.31	5.10
Maghreb	-8.22	6.21	0.45	13.16	65.60	44.48	4.68	24.29	4.61
Selected countries	5.93	15.79	7.34	9.17	63.09	63.73	5.68	37.55	5.49
World	2.17	17.12	4.59	14.91	61.88	53.99	5.52	37.35	5.77

Source: Authors' calculations.

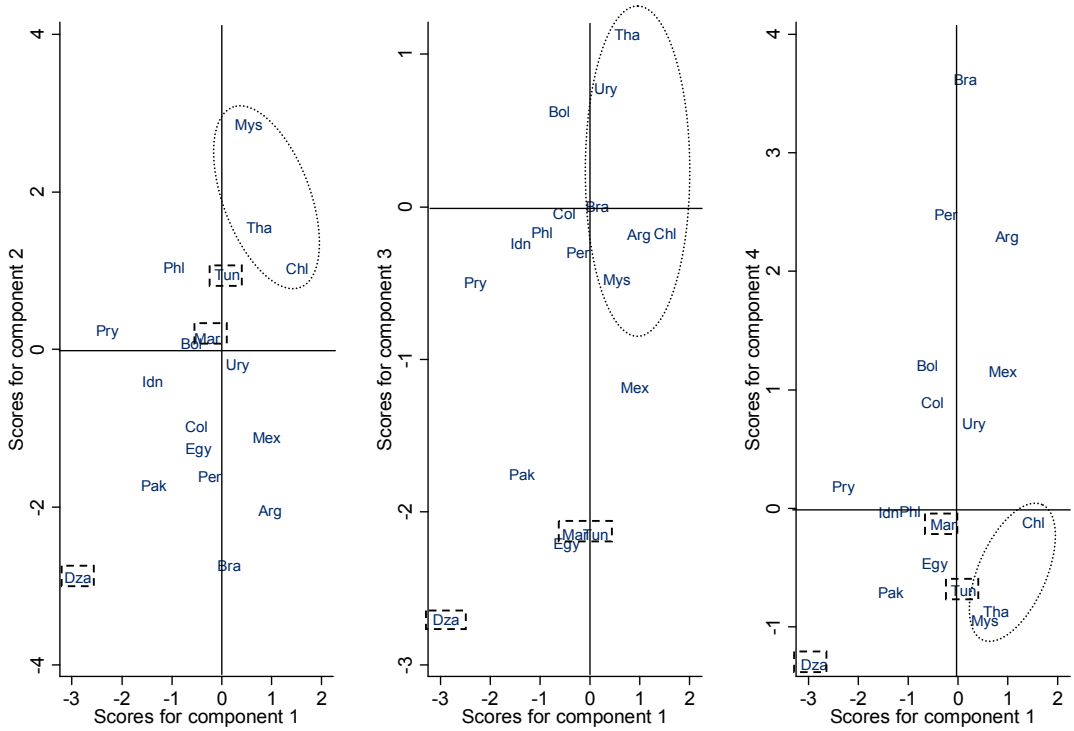
Appendix III: Figures

Figure A3.1. Biplots between the TFP growth and selected macroeconomic, human capital, and institutional indicators, 1985–2005



Source: Authors' calculations.

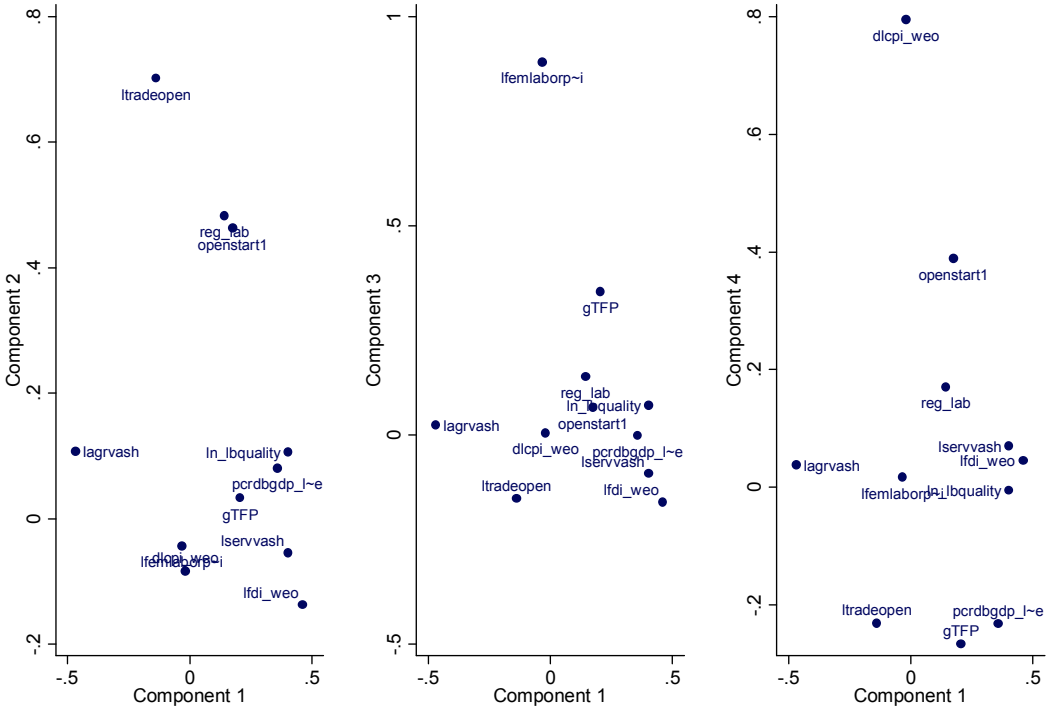
Figure A3.2. PCA: scores of countries, 1985–2005



Rotation: orthogonal varimax

Source: Authors' calculations.

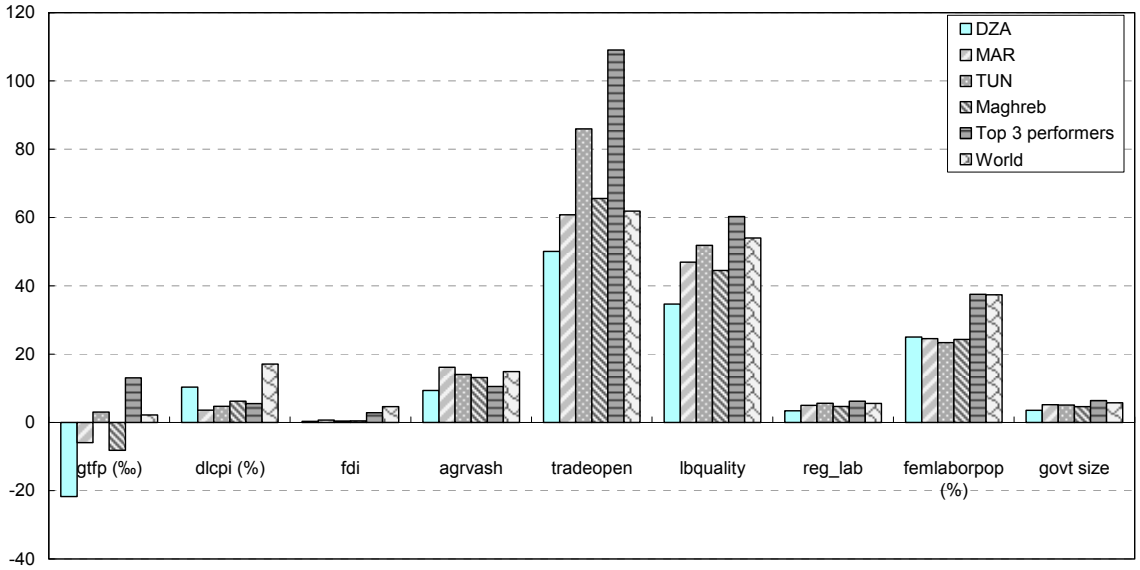
Figure A3.3. PCA: Components loadings, 1985–2005



Rotation: orthogonal varimax

Source: Authors' calculations.

Figure A3.4. Relative performance of countries and regions, 1985–2005



Source: Authors' calculations.