



## REFORMS AND DISTANCE TO FRONTIER

December 10, 2013

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*Policy design aimed at boosting productivity and fostering economic growth is context specific and depends on a country's distance to the global technological frontier. This technical note presents empirical evidence on the drivers of total factor productivity (TFP) and within-sector productivity growth using this conceptual framework, drawing upon supporting evidence from country experiences and the extant literature. The empirical analysis suggests that the reform drivers of productivity growth operate with differing forces across country groups.*

## INTRODUCTION

- Reforms.** Economic theory suggests that structural reforms remove obstacles to the efficient allocation of resources, thereby increasing average income levels. There is general consensus that reducing rigidities in product and factor markets, liberalizing foreign direct investment (FDI), developing financial systems, and freeing international trade are important components of an overall strategy for raising incomes and sustaining economic growth. But do the same reforms matter for fostering productivity growth across all countries? Should policies aimed at furthering economic growth be designed and implemented differently in poor as compared with rich countries?
- Distance to frontier.** A key insight from neo-Schumpeterian growth theory is that the process of economic development is influenced by a country's income gap with the advanced economies that define the global technological frontier (Aghion and Howitt, 2006, 2009). The main growth driver for economies farther away from the technological frontier is the adoption of existing technologies; this process can also be more broadly defined as the implementation of more efficient production techniques. The closer a country gets to the global technological frontier the higher is the relative importance of innovation instead of imitation for sustaining productivity and output growth (Acemoglu, Aghion, and Zilibotti, 2006).
- Appropriate policies.** The theoretical framework outlined above suggests that the set of policies aimed at sustaining productivity growth and fostering convergence at earlier stages of development can be different from those that may be required later. In particular, it emphasizes that the design of policies aimed at fostering economic growth is context specific and depends on a country's distance to the global technological frontier. Therefore, a proper empirical assessment of the relevance of different growth policies requires taking into account the possibility of nonlinear effects arising from a country's distance to the technological frontier.
- This note.** The objective of this note is to provide an empirical assessment of the role of structural and institutional factors in driving productivity growth across different country groups. Specifically, it attempts to gauge whether particular policies and reforms matter more for boosting productivity growth at the aggregate and sectoral levels for some emerging market and developing economies (EMDEs) than other such economies. The role of policy and reform drivers is examined for both aggregate productivity (total factor productivity (TFP) and average labor productivity) as well as for productivity growth in the services and manufacturing sectors. The sectoral productivity perspective can help shed light on the mechanisms underlying aggregate productivity dynamics.

## FRAMEWORK

5. **Policy determinants of productivity.** Notwithstanding challenges in assessing the impact of policies on productivity and growth performance, there is growing evidence that structural reforms and improvements in institutional quality can lead to better resource allocation and greater productive capacity and can foster catch-up. In particular, higher quality and quantity of infrastructure and human capital, trade openness, efficient and well-developed financial systems, and sound economic institutions that promote competition (e.g., strong rule of law and avoidance of overly stringent regulation of product and labor markets), facilitate entry and exit, and encourage entrepreneurship and innovation have been variously found to increase productivity growth at the cross-country, industry, and firm levels (see, among others, Nicoletti and Scarpetta, 2003; Syverson, 2011; Christiansen, Schindler, and Tressel, 2013; OECD, 2013; Prati, Onorato, and Papageorgiou, 2013; Restuccia and Rogerson, 2013).

6. **Empirical framework.** The methodology of this technical note follows the recent literature, which uses the conceptual framework of distance to frontier to examine the association between productivity growth and a wide range of structural, policy, and institutional factors (see Annex 1 for details).<sup>1</sup> In line with the literature, countries are grouped according to their distance to the technology frontier, as approximated by a country's real per capita GDP or productivity gap with the United States (a proxy for the technological frontier). Specifically, countries are classified into time-varying quartiles (denoted by Q1 through Q4, with Q4 being closest to the frontier), and the models are estimated separately for each country group. Low-income countries comprise the first quartile, and most emerging market economies (EMs) now fall into the second (e.g., China, India) or third quartiles (e.g., Chile, Poland). The econometric model, which is estimated using a standard panel productivity growth equation, includes a broad sample of countries and controls for country and time fixed effects.

7. **Reform measures.** The reform and institutional measures chosen for inclusion in the analysis reflect recent theoretical and empirical findings on productivity and growth determinants as well as data availability. In particular, the analysis makes use of recent indices compiled by the IMF of de jure reforms and liberalization in the real and financial sectors. These encompass reforms in domestic financial systems, trade, liberalization of agriculture, and FDI. These measures are supplemented with variables capturing institutional quality (e.g., the strength of property rights protection and legal frameworks) and regulatory restrictiveness (e.g., the extent of business and labor regulations) that have been found to influence economic outcomes in previous studies. Given the paucity of data on improvements in educational quality and detailed product market regulations across a broad sample of countries, these variables are not explicitly accounted for in the regression

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<sup>1</sup> The analysis of sectoral productivity growth allows for an examination of the main channels through which reforms improve aggregate economic efficiency.

analysis.<sup>2</sup> Instead, findings from recent studies that examine these issues for different subsets of countries are used.

8. **Caveats.** Several caveats are in order. First, as with any empirical analysis, it is difficult to account for the complexity of complementarities in productivity determinants. For example, the focus is on the individual effect of reforms rather than on how reforms in different areas interact in their effects on productivity growth. Given that many of these reforms are often implemented as a policy package, this approach could under- or overstate their individual measured impact on productivity growth. Second, issues of reform sequencing that could be critical for reform benefits to materialize (Ostry, Prati, and Spilimbergo, 2009) are not addressed. Third, policy reforms may have nonlinear effects that can be contingent on the quality of political and economic institutions (Acemoglu, Johnson, and Robinson, 2005). The framework does not explicitly account for the role of the broader institutional environment in determining the impact of reforms on productivity growth.<sup>3</sup> Finally, it is important to note that the empirical results highlight associations rather than causation and are illustrative of the types of reforms that would be more effective given income levels.

## EMPIRICAL RESULTS

9. **Findings.** The findings are summarized in Tables 1–2, which are organized as follows: each column reports the coefficients and the standard errors (clustered at the country level) estimated for the full sample (Column 1) and each income quartile (Columns 2–5) across different indicators of reforms. Column 6 in both panels of both tables reports the  $p$ -value of the test for the equality of the coefficient estimates across the different quartiles. Table 1 reports estimation results for TFP and average labor productivity growth, and Table 2 reports results for manufacturing and services sector productivity growth. In general, although the various reform and institutional variables broadly behave directionally the same way across country groups, the size and significance of coefficients are quite different. Thus, there is support for both the commonality of productivity drivers and the dissimilarity of their potency across country groups.

### A. Financial Sector Reforms

10. **Domestic financial reforms.** Efficient financial systems can help increase investment and spur innovation (Levine, 2005), and can allow countries to take advantage of technology transfer. Developed financial systems may also lead to the more efficient allocation of capital across firms and industries (Rajan and Zingales, 2001; Tressel, 2008). The importance of financial sector reforms for increasing productivity growth, however, varies across income groups.

<sup>2</sup> Fiscal reforms (taxes and efficiency of expenditure policies) have been discussed in detail in previous IMF work.

<sup>3</sup> For instance, the literature suggests that sufficiently developed property rights may be a precondition for reaping the productivity and growth benefits of reforms. This empirical analysis instead considers the impact of reforms by countries' distance from the frontier. To the extent that income levels are correlated with institutional quality, the analysis implicitly accounts for this complementarity.

- *Banking sector reforms.* The results suggest that although productivity payoffs from undertaking banking system reforms (including privatization and the strengthening of supervision) can accrue for all countries, lower-middle-income countries (in the second quartile), which tend to have more bank-based financial systems, could benefit most from further banking system reforms.<sup>4</sup> This result suggests that measures to improve access to finance, complemented by prudential policies to prevent excessive risk taking, can support greater investment and efficiency in productive tradable and non-tradable sectors in these countries.<sup>5</sup> Reducing financial repression (e.g., restrictions on the price or quantity of credit) can also help spur the movement of resources to their more productive uses, both across and within sectors. This outcome is consistent with recent firm-level evidence from 10 Eastern European countries, which finds that financial reforms focused on reducing financial repression raised aggregate manufacturing productivity by 17 percent through improvements in the within-industry allocation of resources across firms (Larrain and Stumpner, 2013).
- *Capital market development.* Policies that encourage the formation and development of equity, bonds (particularly local currency bonds), and securities markets can be particularly effective for increasing TFP and labor productivity by lowering the cost of capital and facilitating the financing of new capital and innovation. The magnitude of the coefficient is statistically significant and highest for upper-middle-income countries (third quartile), suggesting that these countries can reap significant productivity gains by further deepening their capital markets. This result is consistent with studies that find that the availability of financial instruments useful for financing the innovation process can be more relevant for countries closer to the technology frontier (Aghion, Howitt, and Mayer-Foulkes, 2005).

## B. Real Sector Reforms

11. **Trade and FDI liberalization.** Barriers to international trade and foreign investment can be detrimental to productivity growth, with an extensive literature showing that more-open economies with lower trade barriers have experienced higher growth (Wacziarg and Welch, 2008).

- *Reducing trade barriers.* The empirical results suggest that reducing trade barriers can raise TFP and average labor productivity growth in low-income countries (Column 2, Table 1). Despite progress during recent decades, tariff and nontariff barriers to foreign trade persist in many EMDEs, preventing efficient allocation of resources and technology transfer. In many low-income countries, especially in Sub-Saharan Africa (SSA), nontariff barriers stymie regional integration and can be a source of low agricultural productivity growth (Tombe, 2012). Reducing such barriers could help to open up new markets, facilitate export diversification, and improve the efficiency of farming, including through better market access, cheaper imported inputs, and greater competition.

<sup>4</sup> In particular, the findings show that the coefficient estimates for the various subcomponents of banking sector reforms are statistically different from each other across the different quartiles, with the coefficients on the reform variables highest for countries in the second quartile.

<sup>5</sup> This result is consistent with Christiansen, Schindler, and Tressel (2013), who find that banking system reforms are positively and significantly associated with TFP growth in low- and middle-income countries.

- *Liberalizing FDI.* The empirical results suggest that liberalization of FDI can boost productivity growth in manufacturing and services sectors in middle-income countries and foster economy-wide productivity gains (Columns 3–4, Tables 1–2). Services barriers in developing countries, especially EMs, on average, are substantially higher than in Organization for Economic Cooperation and Development countries (Borchert, Gootiiz, and Mattoo, 2010). An expanding body of research has documented the positive association between open services markets, FDI in services, and the performance of domestic firms, including on exports. For instance, evidence suggests that the dismantling of entry barriers and the easing of regulatory restrictions for FDI in the services sector tend to be associated with higher productivity in downstream manufacturing sectors across a broad spectrum of countries (see, e.g., Arnold and others, 2012, for India; and Fernandes and Paunov, 2012, for Chile). Given the growing role of the services sector in EMs, further liberalization of FDI could confer important growth benefits. Indeed, evidence suggests that the gains from such reforms can be large: one study finds that if Indonesia were to match the FDI restrictiveness levels of the Republic of Korea, the resulting TFP gains would be on the order of 5 percent (Duggan, Rahardja, and Varela, 2013).

12. **Business regulations.** Heavy regulatory burdens can discourage international participation and sharply limit a country's ability to benefit from knowledge transfers, economies of scale, and production-reallocation efficiencies. Regulations limiting entry may also hinder the adoption of existing technologies by reducing competitive pressures, constraining technology spillovers, and discouraging the entry of new high technology firms, and are more of a detriment to productivity growth as income gaps close (Aghion and others, 2009).<sup>6</sup> Indeed, evidence suggests that OECD countries in which direct and indirect regulatory burdens were lighter have generally experienced higher productivity growth rates (Dall'Olio and others, 2013). In manufacturing, the gains from lowering entry barriers are higher the farther a given country is from the technology leader because strict regulatory settings can curb incentives to adopt new technologies (Nicoletti and Scarpetta, 2003). Firm-level evidence from SSA finds that inefficiencies in the business environment lead to lower sales and affect resource reallocation across firms, capital formation, and production scale (Bah and Fang, 2013). The quantitative effects of these dimensions of the business environment are large, leading to decreases in output and TFP in the ranges of 20–58 percent and 7–19 percent, respectively. In line with these findings, the results suggest that reforms focused on reducing administrative burdens and improving the investment climate are positively associated with higher aggregate productivity growth for middle-income countries and manufacturing productivity growth in low-income countries.

13. **Agricultural sector reforms.** The results suggest that agricultural sector reforms are associated with higher productivity growth in low- and lower-middle-income countries. Moreover, agricultural sector reforms are associated with higher manufacturing sector productivity in low-

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<sup>6</sup> Evidence from OECD countries suggests that low product market competition can impair productivity growth, inhibit new firm creation and business investment, and reduce the speed of diffusion of new technologies and production techniques (Conway and others, 2006). Product market liberalization can also facilitate firm monitoring and encourage managers or state-owned firms to improve efficiency. This impact may potentially be sizable in some EMDEs given their large state-owned sectors, which often create implicit barriers to entry.

income countries (see also Dabla-Norris and others, 2013). This suggests that efforts to scale back excessive government intervention (e.g., export monopolies or administered prices) and boost within-sector productivity (e.g., through appropriate land reforms, tenancy restrictions, and improvements in physical infrastructure and crop yields) can generate economy-wide productivity gains (Adamopoulos and Restuccia, 2011), including by facilitating structural transformation in economies with large shares of agricultural employment. China's recent growth experience provides a case in point—the majority of sectoral reallocation of output and employment toward nonagricultural sectors has been due to rapid productivity growth in agriculture following agricultural reform (Cao and Birchenall, 2013).

14. **Labor market regulations.** The empirical results suggest that removing excessive labor market rigidities can boost aggregate and sectoral productivity growth in countries (in the second and third quartiles) closer to the technology frontier, but the payoffs from such reforms are likely to be limited in low-income countries.

- *Implications of excessive regulations.* In many emerging market economies, the combination of rigid hiring and firing practices, employment protection regulations, and weak income protection systems often makes it costly for labor to move to more productive sectors. Moreover, microeconomic evidence finds that labor productivity and TFP growth tend to be weaker in industries with more stringent employment protection (Bassanini and Duval, 2009). Evidence from country-specific studies also suggests that excessive regulation can slow down job creation in global value chains, causing countries to miss out on jobs-supporting agglomeration effects and knowledge spillovers (World Bank, 2012). Policy reforms to reduce informality can also be important conduits for enhancing productivity.<sup>7</sup> Recent evidence finds a significant correlation between low TFP growth and high levels of informality in Latin America and the Caribbean (LAC)—a 1 percentage point decrease in the informality rate is associated with about a 0.5 percentage point decline in the gap between TFP in LAC versus the United States (IDB, 2013).
- *No one-size-fits-all.* The sheer diversity of institutions, underlying distortions, and misallocations in labor markets across countries renders a one-size-fits-all reform recipe unsuitable. Country experiences indicate that complementary reforms in labor, capital, and product markets can be helpful in facilitating the movement of labor to more productive sectors, enhancing within-sector productivity, and enabling more efficient use of human capital (e.g., reducing labor skills mismatches and shortages) (see also IMF, 2012). For instance, Brazil's experience with labor market reform suggests that reforms aimed at lowering compliance costs, such as the introduction of a simplified taxation scheme for small businesses, supported labor market formalization, thus increasing business efficiency (IMF, 2013).

<sup>7</sup> The causes of informality in EMs are complex, and policy efforts to reduce informality would need to focus on a number of complementary areas, including reducing barriers for firms to create formal sector jobs and providing appropriate incentives for informal workers to shift to formal employment (IDB, 2013).

15. **Strengthening contracting institutions.** Property rights and the ability to enforce contracts are two critical elements of a country's institutional and legal framework. Such institutions can promote private investment and entrepreneurship, foster financial sector development, and improve the efficiency of resource allocation, thereby boosting productivity growth.<sup>8</sup> Indeed, evidence suggests that secure property rights and sound legal systems have a first-order effect on long-term economic growth (Acemoglu, Johnson, and Robinson, 2005). This empirical analysis suggests that all EMDEs can reap productivity gains from improving the quality of their institutional frameworks that protect property rights and facilitate private contracting. The magnitude of the coefficient estimates, however, is highest for low-income countries, suggesting that productivity and growth benefits from strengthening institutions are most pronounced for this group.

16. **Education and research and development.** Human capital is a fundamental determinant of economic growth and long-term living standards. As well as aiding in the development of skills-intensive industries and new technologies, it also influences a country's productivity performance by facilitating technological diffusion between firms. Although not explicitly accounted for in the empirical exercise, previous evidence suggests that primary and secondary education matters more for a country's ability to imitate the frontier technology, and tertiary education has a larger impact on a country's possibility of innovating (Aghion and Howitt, 2009). In particular, as a country catches up to the technology frontier, tertiary education becomes more relevant for growth rather than primary and secondary education (Vandenbussche, Aghion, and Meghir, 2006). Similarly, investment in research and development can enhance long-term income levels by facilitating innovation in countries near the technology frontier and increasing the absorptive capacity of countries not yet there. As countries move up value chains, technology transfer tends to be more skills intensive, requiring sufficient research and development in the recipient country to adapt new technologies to local conditions. Therefore, policies that foster human capital accumulation and facilitate trade and investment opportunities can be viewed as complementary to investment in research and development.

## CONCLUSION

17. **Calibrating reforms.** Although the empirical results are not intended to suggest that the specific reforms discussed in the note should be implemented by all countries in the income group, they emphasize the need for calibrating reforms to the stage of economic development. Moreover, the analysis suggests that reforms need to be continually adapted as income gaps close.

18. **Differing payoffs.** The analysis points to a number of potential productivity- and growth-enhancing policies for EMDEs. In particular, the results suggest that undertaking further financial sector reforms, removing excessively restrictive regulatory barriers in product and labor markets, liberalizing FDI, and improving education quality and secondary and tertiary attainment can have large sectoral and aggregate productivity payoffs in EMs. In low-income countries, strengthening

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<sup>8</sup> Private institutions—sound accounting and reporting standards, transparency, and maintaining investor and consumer confidence—can be just as important for growth. The paucity of cross-country data on these issues, however, precludes an empirical analysis of the role of strong private institutions in boosting productivity.

the economic institutions needed for market-based economic activity, reducing trade barriers, reforming banking and agricultural sectors, and improving the investment climate and basic education could spur productivity growth and help sustain long-term economic growth.

**Table 1. Reforms and Distance to Frontier: Aggregate Productivity Growth**

	Dependent variable: Total factor productivity growth						Dependent variable: Aggregate labor productivity growth					
	Full sample	Q1	Q2	Q3	Q4	Test for coefficient equality (P-value)	Full sample	Q1	Q2	Q3	Q4	Test for coefficient equality (P-value)
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
<b>Financial Sector Reforms</b>												
Banking system reforms	3.272 [0.656]***	2.939 [1.736]*	6.365 [1.545]***	5.933 [1.872]***	0.459 [0.639]	0.001	4.316 [0.720]***	4.538 [1.897]**	7.068 [1.779]***	7.565 [2.030]***	0.363 [0.666]	0.000
Interest rate controls	1.033 [0.307]***	1.24 [0.964]	1.592 [0.737]**	1.429 [0.847]*	0.363 [0.304]	0.052	1.159 [0.337]***	2.23 [1.054]**	1.349 [0.849]	1.657 [0.921]*	-0.033 [0.317]	0.066
Credit controls	1.182 [0.343]***	0.85 [0.986]	2.906 [0.819]***	1.004 [0.815]	0.488 [0.341]	0.053	1.449 [0.377]***	0.891 [1.082]	3.448 [0.941]***	1.34 [0.886]	0.567 [0.355]	0.036
Privatization	1.402 [0.363]***	1.047 [1.011]	2.475 [0.863]***	3.059 [0.879]***	-0.144 [0.372]	0.002	2.013 [0.398]***	1.659 [1.107]	2.972 [0.992]***	3.659 [0.955]***	-0.127 [0.387]	0.000
Supervision	2.206 [0.473]***	4.011 [1.963]**	4.079 [1.251]***	4.926 [1.549]***	0.628 [0.443]	0.001	2.293 [0.520]***	5.205 [2.149]**	4.963 [1.437]***	4.595 [1.691]***	0.912 [0.461]**	0.000
Capital market development	2.359 [0.447]***	2.581 [1.843]	2.077 [1.224]*	6.43 [1.002]***	0.86 [0.431]**	0.001	2.29 [0.491]***	3.091 [2.015]	2.151 [1.409]	6.601 [1.096]***	0.023 [0.450]	0.000
<b>Trade and FDI Liberalization</b>												
Trade (tariff and current account restrictions)	0.497 [0.542]	4.196 [1.490]***	0.19 [1.029]	0.67 [1.099]	1.434 [0.874]	0.015	1.52 [0.588]***	5.054 [1.568]***	0.524 [1.201]	1.327 [1.177]	2.782 [0.812]***	0.001
FDI liberalization	1.472 [0.338]***	1.513 [1.302]	2.799 [0.762]***	1.668 [0.762]**	0.249 [0.351]	0.017	1.94 [0.371]***	2.523 [1.425]*	2.893 [0.879]***	2.249 [0.828]***	0.195 [0.366]	0.005
<b>Institutional Reforms</b>												
Legal system and property rights	0.149 [0.082]*	0.597 [0.220]***	0.372 [0.178]**	0.363 [0.194]*	-0.061 [0.101]	0.045	0.353 [0.090]***	0.941 [0.232]***	0.353 [0.207]*	0.443 [0.213]**	-0.028 [0.106]	0.007
<b>Product Market and Regulatory Reforms</b>												
Agriculture	1.982 [0.458]***	3.806 [1.616]**	3.959 [0.880]***	-0.074 [0.938]	1.115 [0.834]	0.008	2.434 [0.500]***	0.58 [1.129]	4.64 [0.998]***	-0.243 [1.083]	1.633 [0.831]**	0.004
Business regulation	0.491 [0.115]***	0.044 [0.364]	0.704 [0.277]**	0.965 [0.214]***	0.493 [0.128]***	0.024	0.593 [0.125]***	0.394 [0.382]	1.075 [0.318]***	0.666 [0.230]***	0.292 [0.135]**	0.227
Labor market regulations	0.244 [0.113]**	-0.872 [0.582]	0.762 [0.458]*	0.491 [0.115]***	-0.149 [0.107]	0.051	0.289 [0.126]**	-0.931 [0.691]	1.586 [0.338]***	0.569 [0.279]**	-0.077 [0.119]	0.079

Panel regressions consist of relative income gap with US (convergence effects), reform index or institutional variable (lagged one period) entering one at a time, and country- and year-fixed effects. Q1-Q4 denote income group quartiles (based on GDP per capita relative to the United States). Dependent variable is annual growth rate of TFP (left panel) or of aggregate labor productivity (right panel). The full sample consists of over 100 countries for the period 1970-2010. Reform indices are normalized between 0 and 1. \*, \*\*, and \*\*\* indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

**Table 2. Reforms and Distance to Frontier: Sectoral Productivity Growth**

	Dependent variable: Productivity growth in Manufacturing						Dependent variable: Productivity growth in Services					
	Full sample	Q1	Q2	Q3	Q4	Test for coefficient equality (P-value)	Full sample	Q1	Q2	Q3	Q4	Test for coefficient equality (P-value)
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
<b>Financial Sector Reforms</b>												
Banking system reforms	0.414 [0.180]**	0.246 [0.649]	1.246 [0.404]***	0.288 [0.324]	-0.08 [0.299]	0.080	0.651 [0.135]***	0.428 [0.323]	0.71 [0.453]	0.483 [0.174]***	-0.26 [0.210]	0.034
Capital market development	4.687 [1.723]***	-5.065 [8.457]	-0.284 [4.679]	8.201 [2.537]***	-0.481 [1.948]	0.027	1.978 [1.196]*	3.251 [3.691]	2.706 [3.577]	2.234 [1.812]	-0.297 [1.270]	0.513
<b>Trade and FDI Liberalization</b>												
Trade (tariff and current account restrictions)	0.235 [1.931]	4.67 [8.908]	-0.576 [4.254]	3.339 [3.381]	-3.859 [3.534]	0.378	0.288 [1.416]	0.208 [3.665]	2.211 [4.357]	0.993 [2.033]	-3.857 [2.215]*	0.313
FDI liberalization	2.552 [1.107]**	1.118 [3.022]	12.025 [5.795]**	4.128 [1.883]**	-1.435 [1.089]	0.007	2.811 [0.798]***	3.164 [2.089]	4.59 [2.646]*	4.172 [1.467]***	-0.331 [0.703]	0.004
<b>Institutional Reforms</b>												
Legal system and property rights	0.179 [0.306]	-0.804 [1.423]	-0.675 [0.912]	0.893 [0.459]*	0.349 [0.351]	0.046	-0.028 [0.233]	1.776 [0.586]***	-0.163 [0.783]	-0.038 [0.356]	-0.228 [0.206]	0.007
<b>Product Market and Regulatory Reforms</b>												
Agriculture	3.146 [1.426]**	9.042 [5.203]*	-0.524 [3.777]	-2.866 [2.362]	13.232 [5.793]**	0.015	2.385 [1.120]**	0.733 [3.339]	3.444 [3.210]	-1.315 [1.636]	3.718 [3.407]	0.070
Business regulation	0.757 [0.503]	5.255 [2.428]**	1.037 [1.161]	0.337 [0.941]	-1.107 [0.621]*	0.012	-0.076 [0.520]	-1.5 [1.061]	-3.45 [2.878]	-0.03 [0.573]	-0.936 [0.439]**	0.204
Labor market regulations	0.501 [0.338]	0.936 [4.282]	4.007 [1.051]***	0.592 [0.751]	0.861 [0.379]**	0.000	-0.095 [0.298]	1.833 [1.484]	2.708 [1.306]**	0.638 [0.451]	-0.047 [0.240]	0.073

Panel regressions consist of sectoral productivity gap relative to the United States (convergence effects), reform index or institutional variable (lagged one period) entering one at a time, and country- and year-fixed effects. Q1-Q4 denote income group quartiles (based on GDP per capita relative to the United States). Dependent variable is annual growth rate of manufacturing productivity (left panel) or of services productivity (right panel). The full sample consists of more than 90 countries for the period 1970-2010. Reform indices are normalized between 0 and 1. \*, \*\*, and \*\*\* indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

## ANNEX I

### **The model**

The following specification is estimated using ordinary least squares:

$$\Delta y_{i,t} = \alpha + \beta y_{i,US,t-1} + \gamma X_{i,t-1} + \mu_t + \nu_i + \varepsilon_{i,t}$$

in which  $y_{i,t}$  denotes the logarithm of productivity level (TFP, or aggregate and sectoral labor productivity) in country  $i$  at time  $t$ , and  $\Delta$  is the difference operator (so that the dependent variable is the annual productivity growth rate). The one-year lag of productivity gap with the United States,  $y_{i,US,t-1} = y_{i,t-1} - y_{US,t-1}$ , is included to capture convergence effects. The expression  $X_{i,t-1}$  is the one-year lag of each reform indicator or institutional variable, which enter one by one in the regressions;<sup>9</sup>  $\mu_t$  is the year dummies; and  $\nu_i$  is the country dummies. The country fixed effects control for any time-invariant country characteristics (such as geographical location, historical legacies, and legal origins) that could affect both productivity growth and adoption of reforms. The empirical analysis is based on an annual panel data set of more than 100 advanced, emerging market, and developing economies between 1970 and 2010.

### **Data sources**

Measures of TFP and aggregate labor productivity growth are taken from the Penn World Tables (PWT, version 8.0). Average labor productivity in manufacturing and services sectors are calculated as real value added per worker, using sector-level value-added data from the UN National Accounts database and sector-level employment from a combination of sources: the International Labor Organization, the World Bank's World Development Indicators, and the Groningen Growth and Development Center (GGDC) database. Per capita GDP data (to calculate distance to the frontier) are from PWT (purchasing-power-parity-adjusted constant U.S. dollars).

The primary measurement of structural reforms used is the structural reform indices compiled by the International Monetary Fund (2008). This database includes annual indicators of enacted reforms in international trade, banking, the financial sector, and liberalization of agriculture. All reform indices are normalized to range between 0 and 1, with higher values indicating greater reforms. These indicators of structural reforms are complemented with other institutional variables, including the quality of labor market institutions and business regulations as captured by the Fraser index, with higher values denoting less-restrictive regulations. To check the robustness of the results, alternative data sources for institutional quality and business regulations were also considered.

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<sup>9</sup> Some reforms may have complementary effects and may be implemented as a package (e.g., product and labor market reforms), so that the correlation in reform indices renders it challenging to include all types of reforms together in the regression. The estimated effect of each reform included one by one may be viewed as the upper-bound impact. We also recognize that the impact of some reforms may take a longer time to materialize. The illustrative regressions focus on the short-term impact of reforms, leaving a more comprehensive analysis of the dynamics to a forthcoming paper (Dabla-Norris and others, forthcoming).

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