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Determinants of productivity: cross-country analysis and country case studies

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Determinants of Productivity:
Cross-Country Analysis and Country Case Studies

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Abstract

This paper compares the results of TFP determinants through two modes of analysis — cross-country analysis of large sets of countries and country case studies. Both modes of analysis strongly agree on the most important TFP determinants, although they attach dissimilar weights to different variables. Agreement was obtained with respect to determinants such as human and physical capital, infrastructure, financial development, technology transfer through trade and absorptive capacity regarding knowledge creation, privatization and trade liberalization to achieve increased competition and economic institutions. Diverging views were evident in the case of structural change, health and geography. The paper concludes that a combination of both modes of analysis offers the most valuable tool for policy makers as well as for researchers.

Keywords: Total factor productivity, cross-country analysis, country case studies

1. Introduction

In this paper, the results obtained from two modes of analysis (hereinafter referred to as "Modes") are discussed to uncover the determinants of total factor productivity (TFP) growth.[1] The first is a standard cross-country regression analysis, where the analyst purports to explain TFP growth with a number of variables thought to influence its evolution. Because the variation exploited in such analyses is between countries – although the time variation is sometimes also considered – the results reveal an average picture. Assuming that across countries, for example, human capital is positively associated with TFP growth, the conclusion drawn is that this is *generally* true for all countries in the sample.

Although, on average, this was certainly true, there are likely to be important exceptions, but those are undetectable in this kind of analysis. From a policy maker's viewpoint, human capital, in general, is considered important but it is not known whether this holds true for particular countries or, perhaps, better stated, whether a country has the pre-conditions necessary for human capital to have a positive effect. Country case studies[2] provide for a second Mode. By asking country experts to discuss the same standard set of determinants normally used in regression analysis and explaining why and how or, in some cases, why a particular determinant is, or is not, important, one is in a better position to detect essential information that would otherwise remain buried after the regression analysis.

The purpose of this paper is to compare the findings of the two modes of analysis. This will enable one to determine when one can generalize, when one should attach conditions to determinants or when one should simply avoid drawing conclusions based on cross-country regression analysis. A short summary of the general results

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1 The discussion here is based on what has been learned from a UNIDO project entitled "Productivity Performance in 17 Developing Countries" and in which two modes of analysis were used to obtain information on TFP determinants. Isaksson (2006a) and Ng (2006) summarize the findings from cross-country regressions and country case studies, respectively. More information on this project can be obtained from the authors.

2 The 15 countries covered in the country case studies are: Argentina, Brazil, Chile, China, Egypt, India, Indonesia, Kenya, Mexico, Morocco, Nigeria, Republic of Korea, South Africa, Uganda and United Republic of Tanzania.

obtained is followed by an examination of the extent to which the country-case studies alter the view of the determinants of TFP. The final section concludes this note.

2. Summary of results obtained

2.1 Creation, Transmission and Absorption of Knowledge

Cross-country regression. At macro level, the impression is that knowledge is important to overall economic growth and that it works through various facets of TFP growth. Some results suggest a long-term relationship between TFP and research and development (R&D). However, there is evidence that the number of innovating countries has increased over time. Industry-level data appears to support the macro results, while some conflicting results are obtained at micro level. However, universal agreement is lacking that R&D is important. It has been suggested, for example, that it is the use of innovation that matters rather than input. This is interpreted to be in line with an institutional view, where countries with strong institutions obtain a higher output per investment in R&D. Other reasons for adopting a somewhat cautionary view of the positive effects of R&D for the case of developing countries include that the effect has been shown to be small, that its measurement seem flawed and that country samples normally exclude developing countries.

Two transfer channels for technology are discussed: foreign direct investment (FDI) and international trade. For the former, it seems that inward investment has positive effects in industrialized countries, while for developing ones this does not seem to be the case. This result may, again, suggest that institutional quality and absorptive capacity matter, but could also suggest that the kinds of FDI differ depending on the target country. In developing countries, FDI might simply be more extractive. Trade seems a more promising channel for technology transfer, but there are, again, strong indications that the efficiency of transfer depends on the absorptive capacity of the recipient country. For such capacity, it is mainly human capital and capital intensity that matter.

Country studies. In Latin America, technology transfer from abroad is far more important than own creation of knowledge. In general, R&D expenditures have not increased significantly, but this has been countered by FDI. Brazil might represent an exception in that domestic creation has had some impact on TFP growth.

In Africa, R&D and FDI have, in general, been low, with the latter mainly confined to extractive sectors, such as oil and mining. Reasons for low R&D, as stated by country experts, include lack of adherence to intellectual property rights, inadequately sized firms, lack of scientists and engineers and weak links between the private sector and universities. The situation of FDI is not as negative and, since it is being directed into machinery purchase, TFP tends to be positively affected.

Likewise, the Arab region, as exemplified by Morocco, is weak in terms of own knowledge creation. In particular, the connection and coordination between research units and laboratories, on the one hand, and the production sector, on the other, has been an obstacle. A clear policy on research is missing, and research results obtained are not evaluated.

In the case of Asia, the Republic of Korea is a star performer in terms of domestic knowledge creation. Like other developing countries, it started by importing technology. Owing to a strong absorptive capacity, the country was able to assimilate relatively advanced knowledge. Public sector R&D institutions were the origin of the country's own knowledge creation, but in the past 10-15 years, the private sector has taken over this role. China is partly imitating this sequence, but is still at a much lower level.

The general finding of the country studies is that, with few exceptions, own knowledge creation is lacking and that it is technology transfer from abroad that counts for technology.

2.2 Factor Supply and Allocation

Cross-country regression. In the former section, it was argued that human capital is important for a country's absorptive capacity. However, the literature review (hereinafter referred to as "Review") also considers its role in the production process, but regression analysis is seen to yield mixed results. In relatively rich countries, for example, human capital is important, while, in relatively poor ones, it has a negative effect. Going beyond education, one finds human capital in the form of training to be important. It is even more important in the form of health, which in all studies shows a strong positive effect, that is, productivity is positively related to better health. One explanation for why education does not seem to impact positively on growth in developing countries could be that the health level is too low for efficient learning – this could hold true in especially least developed economies. This points to the importance of accounting for quality of education in addition to quantity but, perhaps, also to that of policy priorities, in other words, health before education.

Public capital, in particular, in the form of infrastructure, has an important effect on TFP growth. There is even some evidence of causality running from infrastructure to growth. Research has also addressed how public investment is financed, and it seems that an allocation of public expenditures is preferred to an increase in public debt. Crowding out of private capital formation does not seem to be of great concern. Instead, the management of public capital has proven to be very important suggesting that institutions matter strongly.

While there seems little evidence for the empirical effects of structural change on TFP growth, there are certainly indications pointing in that direction. Yet, decomposition exercises show that most of productivity growth comes from within-industry and within-plant effects. One study's results suggest, however, that market frictions hinder an economy's ability to allocate efficiently output and inputs across businesses. In terms of firm turnover dynamics, net entry seems to be important, with entrants being more productive than exiting plants.

Finally, although based on only a few studies, there is strong evidence for the notion that financial development is good for, and financial repression bad for, resource

allocation, capital accumulation and the incentive structure. Financial development is also seen to impact on the speed of convergence, through its effect on TFP growth.

Country studies. In general, human capital (education) is seen to be important for explaining TFP growth, both positively and negatively. In Latin America, quality and relevance — rather than stock — of human capital have played a role. Accumulation of physical capital is important but, interestingly, the highest accumulation occurred during the import-substitution, not in the post-liberalization phase. Worsening fiscal conditions have reduced the quality of infrastructure in Brazil, while in Chile the stock of infrastructure has increased rapidly. The effects on the two countries' TFP have been negative and positive, respectively.

All the Asian countries sampled have accumulated human capital at a rapid rate, which has had a profound effect on TFP growth. The quality as well as the quantity of human capital has increased. In terms of physical capital, the region is also performing well. An interesting difference between China and the Republic of Korea, on the one hand, and Indonesia, on the other, is that the latter funded investment with foreign capital while the former used domestic capital. This made Indonesia much more vulnerable at the time of the Asian financial crisis. Hence, how investment is funded matters as well. China has reformed its financial system, which has greatly improved the efficiency of funds allocation, as evidenced by a higher average profit rate. Another contributor to TFP growth in China and the Republic of Korea has been structural change from agriculture to manufacturing.

In the Arab region, lack of human capital is hindering TFP growth. In the case of Egypt, it seems that, although education has existed, the needed training for work in the private sector has been lacking. This suggests complementarity between education and training. Another issue is that many skilled workers end up in the public instead of the private sector. Brain drain is yet another concern. Lack of infrastructure has been one of the factors behind slow economic growth in Morocco. It is chiefly the kind of services that seems inappropriate. In Egypt, investments in infrastructure have increased and contributed importantly to TFP growth.

African countries have performed worse than the Arab states with respect to human capital. While brain drain is a significant concern, government investment in human capital is low. In the case of health, the effects of AIDS have had a strong negative impact on TFP in all African countries considered in this study. A difficult business environment has had negative effects on capital accumulation. In addition, capital stocks tend to be of old vintage and low quality. Poor infrastructure coupled with high cost for its services have had a negative impact on TFP growth in all sampled African countries. In fact, infrastructure has been identified as one of the main constraints on productivity performance.

In short, the country studies reveal that the explanation for poor infrastructure may be rooted in lax fiscal discipline. They also show how lack of education and an undeveloped financial system can deter TFP growth.

2.3 Institutions, Integration and Invariants

Cross-country regression. Starting with macro-based studies, trade-(TFP) growth literature has received considerable criticism, in particular for not properly addressing such statistical problems as endogeneity bias and for omitting institutions and geography from analyses. Correction for endogeneity and inclusion of institutions and geography have a tendency to render total trade statistically insignificant. One component of trade, imports, has, however, been shown to be robustly associated with productivity. Micro literature reveals considerable heterogeneity in the data. For example, there is evidence that trade liberalization has a greater impact on large plants and in industries where competition is low. Furthermore, it is mainly relatively unproductive firms that benefit from trade liberalization because either they have to improve or exit. Relatively productive firms suffer less from increased pressure because they have a buffer. Trade liberalization has also been shown to affect positively access to foreign capital, in the form of technology as well as to lower its price. The import effect also shows up in micro data. On the export side, it seems that learning effects are very small or non-existent. There is even evidence suggesting that causality runs from productivity to exporting. Trade openness as a policy, it can be concluded, is important, but in terms of outcome, it is imports that matter for TFP.

In the case of institutions, a division is made between political and economic institutions. For the former, the results are inconclusive. However, there are some indications that democracy and economic freedom may promote TFP and have a negative effect on capital accumulation but that the net effect on overall growth is positive. In the case of economic institutions, there is overwhelming evidence favouring the notion that institutional quality has a distinctively positive effect on productivity level and its growth rate. In empirical work focused on the long run, institutional quality tends to "eliminate" trade, while geography (invariants) remains.

A follow up question is why some countries seem to keep institutions that are apparently bad. A suggestion is that some powerful groups benefit from the situation and, therefore, have no interest in policies that would alter it. An interesting result is that institutions actually might be caused by human capital.

Adverse geography is clearly shown to affect possibilities for benefiting from the fruits of technology transfer. This obviously impacts on TFP growth. Some evidence suggests that geography might work entirely through its effect on institutions, but there are also indications of direct effects.

The overall conclusion for these three determinants is that institutions, geography and imports – but not trade as a whole – exert strong first-order effects on TFP growth.

Country studies. In Latin America, the poor institutional structure – possibly traced back to inequality among wealth, human capital and political power – is seen as a key impediment to TFP growth. These countries have had mixed experiences from trade liberalization, where most of the productivity benefits have come from the imports side. In this case, however, trade liberalization implies increased competition from imports, rather than increased imports of foreign capital or learning from importing. Positive results of liberalization were enjoyed by Argentina (increased imports and competition effect) and Chile, while Brazil and Mexico performed worse than during pre-liberalization. In the positive case, it is not entirely clear that trade policy per se is the critical factor, as trade openness is part of an overall reform package. In Brazil, imports do not seem to have increased enough to threaten domestic producers. In Mexico, there are too few large companies for the country to benefit significantly

from foreign technologies. Interesting exceptions to the total-economy picture in Brazil and Mexico occurred in their respective manufacturing sectors, where in both cases TFP increased.

In Asia, the Indian case study suggests that the most critical determinant of TFP performance has been a change in the incentive structure. This, in turn, resulted from changes in institutions that drive the growth process. With a new incentive structure in place that rewarded productive investment, the result was stronger competition and a greater degree of integration (suggesting that integration is a function of institutions!) that have both improved TFP growth. The Republic of Korea has integrated successfully into the world economy. Important here has been its export-led industrialization strategy. Increased openness has implied a significant amount of advanced technologies going to China, through international trade. In India, lack of openness has hampered TFP growth. Recent opening up has reduced this disadvantage, but the country remains relatively closed.

In Africa, the Kenya study shows that the country has done well in terms of integration, which is likely to have had a positive impact on TFP growth. In South Africa, trade openness has increased competition. However, because of lack of navigable internal waterways, the country has suffered from high transport costs, which have exerted constraints on export-oriented industries and industries dependent on imported inputs. In Uganda, it is argued that the country has faced difficulties in participating fully in the global economy due to it being landlocked.

In the Arab countries, Morocco has recently worked considerably on the integration side. Furthermore, integration mainly seems to have concerned capital goods, while other tariffs have remained high. It is, however, too early for an evaluation. The Egyptian country study argues that the country still lags behind in terms of international integration.

The country studies as a whole show that different institutional structures have an impact on TFP performance. They also corroborate the finding that importing constitutes the crucial trade component, mainly due to its effect of introducing increased competition. Finally, geography does not seem to be a major issue.

2.4 Competition, Social Dimension and Environment

Cross-country regression. Empirically, there is mild evidence in favour of privatization, that is, former State-owned enterprises tend to improve their performance following privatization. Empirical results also suggest that stringent regulatory settings in the product market decrease productivity. One conclusion is that competition is significant for TFP growth.

Literature on the relation between social dimension and TFP is limited and inconclusive. Some results, however, suggest that social diversity is associated with lower productivity. With respect to income inequality and productivity, it is difficult to draw conclusions. Land inequality, conversely, appeared to be negatively related to at least labour productivity and, perhaps, to TFP as well. From the even smaller age structure literature, one learns that high youth dependency ratios negatively correlate with TFP growth.

Early literature on productivity and environmental regulation maintain that regulation is negative for TFP, but more recent work appears to suggest otherwise. There are actually some indications that environmental regulation may lead to a faster rate of technological change.

Country studies. In Latin America, import-substitution has been largely abandoned, but the effects of the move towards greater competition have differed across countries. Privatization in Chile has been successful because it ensured the abolition of State-protected monopolies, whereas in Mexico and Argentina privatization has been less successful because the goals were not to increase competition but to maximize State income (Mexico) or reduce State-owned companies' inefficiency (Argentina). All countries, except Brazil, have experienced problems with privatization, the main one being the shift from State to private monopoly, in which competition cannot play a role. Income and wealth inequality remain a major problem in the region and impede equal access to education and, hence, TFP growth.

In Asia, the aim of the Government of the Republic of Korea has been to maintain the degree of monopolistic competition but control it, as evidenced by gradual lowering of entry barriers over time.

For the Arab region, although in Morocco a competition law has been introduced, there are still many barriers to entry of both foreign and domestic investments. Hence, it seems that competition efforts have been undermined.

In Africa, privatization has led to higher TFP in the case of the United Republic of Tanzania, with its many State-owned enterprises. The legacy of apartheid is argued to have a strong lingering effect on productivity by creating a dual economy: one that is highly developed with firms using modern technology and one that is characterized by high poverty as well as un- and under-employment. This situation is thought to impact negatively on TFP growth, for example, by increasing social tensions.

The difficulties and necessary preconditions for successful privatization are clearly revealed in the country studies. There is also some evidence of how the social dimension may impact on TFP growth. However, none of the country studies touches on the role of environment.

3. Lessons

In bringing together the results of the two Modes discussed, one can start by emphasizing the areas where they unanimously agree. Thereafter, discrepancies are explored in terms of conditions that need to be fulfilled for determinants to play their roles. Finally, areas where the two Modes appear to disagree are highlighted. It should be noted that incongruity might stem from one of the Modes *not* discussing the variable as well as from outright disagreement.

3.1 Agreement

Both Modes suggest that education plays an important role in the production process for TFP growth. In particular, the poorer the country, the larger the returns from

education it seems. The country study on Egypt, however, signals concern about whether the educational system is able to produce enough of the needed workforce, such as scientists and engineers. In Latin America, the quality of education is a concern. In African countries, AIDS emerges as a major deterrent to TFP growth. The Review strongly emphasizes the role of health in general. The Review also emphasizes the role of training, which is mentioned in the case of Egypt, as well. It seems clear that human capital — the term encompassing both education and health — is critical for productivity growth.

The Review is only able to show that R&D is important for industrialized countries, but one reason for this result may be the lack of studies on developing countries. The country-case studies find that, in general, own knowledge creation has been low. The Republic of Korea appears, however, to be an exception in this respect. Both Modes stress the role of technology transfer, that is, openness to foreign technologies. To this end, the trade channel is especially emphasized. In conjunction with this, the Modes also make clear that, unless absorptive capacity exists, much of the potential benefits of technology transfer will bypass developing countries. In addition to the role played by human capital in the production process, it also represents an important factor for technology adoption.

The importance of infrastructure features prominently in the Review, whose significance is corroborated by the country studies. The country case studies depict the impact of fiscal constraints on the quality of infrastructure and their negative impact on TFP growth in the case of Brazil, whereas in Chile, investment in infrastructure has been rapid, with an ensuing positive effect. The Review also suggests that management of infrastructure may matter more than its sheer existence. An additional concern considered is that of financing, where incurring debt is seen to be counterproductive. The country studies also mention that the kind of services provided by the existing stock of infrastructure matters as well.

The Review takes for granted that physical capital is essential to productivity performance, based on evidence discussed in Isaksson (2006b). The country studies select, in particular, Asia as a star performer in this respect but raise concerns about its

source of financing — domestic or foreign — where the former is less vulnerable to such shocks as the Asian financial crisis. Due to a difficult business environment in Africa, investment in capital has suffered. Hence, the reigning business climate can explain to what extent investment is able to affect productivity performance.

The Review argues for financial development, while the country-case studies mention lack of credit to be a hindrance to TFP growth. Lack of credit could also be a symptom of inefficient allocation of investment, rather than actual lack of credit, thus underscoring the negative effects of financial repression. In Latin America, the financial systems are less developed, therefore, acting as a deterrent to TFP growth.

The case studies contain countries with different types of political institutions, and it seems that economic performance has been largely detached from such influence, at least this is not highlighted by the country experts to be a major factor. The Review tends to agree with this finding.

The Review emphasizes the importance of economic institutions; likewise the country studies indicate that such institutions are key to TFP performance. The case of India shows the impact of a change towards good institutions, while in Latin America, poor institutional structure is seen as a serious impediment to TFP growth.

Integration or trade is argued to be important in both Modes, but it is crucial to note that, in general, imports matter more than trade. The difficulty is disentangling the role of actual trade from trade policy towards openness. Trade liberalization that increases access to foreign capital and, thereby, to embodied foreign technologies and implies a non-destructive increase in competition is viewed positively in both Modes. Latin America is a good example of the imports effect, in both positive and negative ways. Although the Republic of Korea has greatly underlined the significance of export-led industrialization, there is little evidence for the role of exporting, except for that of financing imports. There is also some evidence that integration may be a function of institutions.

Being beneficial to TFP growth, it is agreed that privatization is best undertaken gradually, while ensuring that development of a regulatory framework keeps pace

with it. One particular risk to avoid is that of turning a public monopoly into a private one. In addition, the *purpose* of privatization is essential and the country studies for Latin America depict cases of dubious motives leading to other results than TFP growth. Positive effects of privatization are evident in the case of the United Republic of Tanzania, where the large number of State-owned enterprises generated considerable inefficiencies. Competition is deemed be essential to productivity, with the country-case studies proposing trade liberalization, for example, as a means to this end.

Despite being based on little evidence, both Modes suggest that social inequality might constitute a deterrent to TFP growth, especially by creating political instability, which reduces vital investments in human and physical capital.

3.2 Agreement with conditions

Whereas the country-case studies appear to recommend foreign direct investment (FDI), the Review is less convinced. However, both agree that FDI can play a role if the absorptive capacity of recipient countries is strong.

3.3 Disagreement

Although there was some evidence of traditional type of structural change, that is, agriculture to manufacturing, being important for the Republic of Korea and China, in the Review this is argued to be of relatively minor significance. More central are obstacles to turnover dynamics, that is, the ability of the economy to let firms enter the market.

While the Review has discussed health-related issues at great length and called attention to its significance, aside from AIDS, the country-case studies did not really touch on this. It is not entirely clear whether this means that health is of little concern to non-African countries.

The negative role of hostile geography has received much attention in the Review, while it is mentioned only in the case of South Africa and Uganda. Thus, the country experts do not appear to attach much weight to geography as a determinant of TFP growth. It should, however, be mentioned that this determinant is more likely to show up when analyzing cross-country variation, which is what occurs when South Africa and Uganda are discussed.

4. Conclusions

This paper contrasts the results of TFP determinants through two modes of analysis. The first is based on regression analysis of large sets of countries — industrialized and developed — while the second presents evidence on 15 selected country cases. Both analyses shared the same framework in terms of selected determinants, although the hope was that cross-country heterogeneity hidden in regression analysis would be unveiled by the country studies. In several cases, this did indeed materialize.

In general, both modes of analysis strongly agree on the most important TFP determinants, although they attach dissimilar weights to different variables. No hesitance was obtained with respect to determinants such as human capital (education and training), physical capital including infrastructure, financial development, technology transfer and absorptive capacity regarding knowledge creation, privatization and trade liberalization to achieve increased competition and economic institutions.

With respect to technology transfer, two channels -- trade and FDI -- were analyzed. Whereas the Modes agree on the role of trade in this respect, there is some disagreement as to the contribution of FDI. In particular, the literature review argues that domestic conditions play a central role for FDI to be beneficial.

Diverging views are evident in the case of structural change, where the country studies suggest that the agricultural-to-manufacturing shift is important for TFP growth, while the cross-country regression evidence for it is weak. The country studies also place little emphasis on health — AIDS in Africa being an exception —

and geography where, again, the exceptions were found in Africa. Although empirical evidence is found to be strong for these two determinants, they are of minor concern in the sample countries.

Was there any significant cross-country heterogeneity? For education, the country studies point to the need for educational systems not to only supply education as such but also the required one, which is, in the case of Egypt, more scientists and engineers. The same need was advanced in the case infrastructure as well, in that what matters is the kind of infrastructure services. Furthermore, a determinant of infrastructure investment is the fiscal situation, as highlighted in the case of Brazil. Therefore, a simple regression between TFP growth and education/infrastructure may prove merely superficial, without showing the genuine underlying factors.

Although investments in physical capital are, doubtless, important for productivity performance, it is likely to be sub-optimal unless the financial system is developed to the point that funds are allocated to the most profitable projects. Hence, although high capital accumulation can be achieved with a poor financial system, it will not be as productive as that obtained from one that is well functioning. In addition, the business environment, in general, seems an important pre-condition for investing. Accounting for this somewhat subtle feature of capital deepening in regression analysis appears challenging.

It seems clear that much of the incongruous results obtained from TFP growth-trade regressions, and, probably, also for GDP growth-trade, may be due to improper understanding of how trade actually impacts productivity performance. First, TFP growth seems best regressed on imports and, perhaps even better, on imports of machinery and equipment. The reason is that foreign capital tends to embody relatively advanced technology. Secondly, another role of imports is to increase the degree of competition, which is clearly revealed in the country studies. In regression analysis attempting to learn about the effects of imports, competition, as a variable, should, therefore, be controlled. Thirdly, trade policy should not be confused with actual trade. In so far as trade opportunities created by, for example, trade liberalization are immediately and completely reaped, these are likely to be identical. As this is unlikely to be the case, these concepts should be analyzed separately.

Fourthly, the country studies show that trade liberalization can cut both ways, depending on economic conditions in which policy is implemented. Finally, it seems that integration and trade are functions of institutions.

In conclusion, both modes of analysis appear valuable, although they pose somewhat different questions. Regression analysis more or less sketches an average picture without saying much about under what conditions determinants can be expected to influence TFP growth. Such general information is, doubtless, indispensable, but for a policy maker interested in a particular country, a sketch will not suffice. Therefore country studies, which paint in the fine details, provide a very valuable complement to the general picture of the world. The combination of the two modes of analysis is, however, what offers the most useful tool for policy makers and economic analysts.

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