ERSA Research Brief
June 2016

Output Decomposition in the Presence of Input Quality Effects: A Stochastic Frontier Approach

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Several contributions explain countries' rates of real output growth. However, there is no unanimous answer about the most significant determinants of such growth. The answer from growth accounting sees the separation of growth into two components: one component related to factor accumulation, most often accounted for by physical and human capital, and the other accounted for by Total Factor Productivity (TFP). The relative contribution of factor accumulations and TFP to total growth has animated the growth literature for more than two decades and there is no consensus about the most important factor of growth. This paper approaches the question about the determinants of output growth by focusing on input quality, namely the level of education of the population (human capital) for labor and the age of the capital stock for physical capital.

While human capital is generally acknowledged as important, less attention is given to the quality of physical capital. We use the average age of physical capital to account for the quality of physical capital, and regard physical capital as contributing more to output the newer it is. We therefore build a unique data set on the average age of capital stock for 90 countries grouped into five regions (Africa, East Asia, Latin America, South Asia, and West) and over the period 1960-2007. We subsequently determine, through stochastic frontier analysis, the relative contributions of physical capital accumulation and TFP to growth in each group. In a stochastic frontier framework and in the presence of input quality effects, TFP change decomposes into changes in input quality, technical efficiency, and technology.

Our principal findings can be reported quickly. The decomposition of output growth demonstrates that physical capital accumulation generally proves much more important than either the improved quality of factors or TFP growth in explaining output growth. The age of capital decreases growth in all groups except in Africa (the older the capital, the slower the growth), while education increases growth in all groups except in East Asia. Technological change exhibits the highest effect on growth in East Asia and the lowest in Africa. Finally, our findings indicate that whenever the age of capital is significant and with the right sign, technology is improving.

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Two normative considerations naturally emerge from our study. The first regards the average age of the physical capital stock. Our growth decomposition shows that the age of physical capital decreases growth in four out of five groups (even if this effect is relatively small). This result hints that the old age of physical capital in these groups can be an obstacle to growth. To enhance growth, these groups should invest in newer physical capital that embeds more recent technology. The second normative consideration is about the role of technological change in developing countries. Africa and South Asia are the only two groups where the contribution of technological change to total output growth is negative. These are also the groups with the lowest average level of education. This indicates that there is an absence of human capital to successfully adopt and absorb foreign technology. Countries in these two groups ought to invest more in education if they want foreign technology to translate into growth.