Human capital aggregation and relative wages across countries

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A R T I C L E   I N F O

A B S T R A C T

Most of the growth accounting literature relies on an aggregate production function to determine the contribution of factors of production relative to that of total factor productivity (TFP) in explaining differences in incomes across countries. I show that the importance of TFP in accounting for cross-country income differences depends crucially on how skilled and unskilled labor are aggregated. Further, cross-country evidence on the relationship between relative wages and relative endowments of skilled and unskilled labor suggests that the two types of labor should not be aggregated into a single factor of production. Growth accounting decomposition using a commonly used nested-CES aggregate production function that allows skilled and unskilled labor to be used as separate factors of production results in a significantly greater role for TFP in accounting for income differences across countries than that found by past studies. The finding that different aggregate production functions lead to significantly different conclusions about the role of TFP in accounting for cross-country income differences calls for a more general approach to understanding such differences.

1. Introduction

Most of the growth accounting literature relies on the use of an aggregate production function (APF) in order to evaluate the contributions of human capital, physical capital and total factor productivity

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(TFP) to differences in incomes across countries.[1] In this paper, I show that the relative importance of TFP in accounting for cross-country income differences depends crucially depends on how skilled and unskilled labor are aggregated.

Previous studies, such as Klenow and Rodríguez–Clare (1997) and Hall and Jones (1999), aggregate skilled and unskilled labor into a single factor of production, human capital, when evaluating the importance of TFP. To begin with, I show that the importance of TFP depends on the value of the substitution parameter used for the aggregation by these studies.[2] To do so, using data for 51 countries, I consider a growth accounting exercise similar to that of Hall and Jones (1999) under different values for the substitution parameter and, for each country, compute TFP relative to that of the US.[3] Relative TFP for all countries increases when the substitution parameter is decreased from 1 (skilled and unskilled labor are perfect substitutes) to 0.75 (imperfect substitutes), indicating that the degree of substitutability between skilled and unskilled labor plays a crucial role for determining the importance of TFP in accounting for cross-country income differences.[4]

Given the importance of the substitution parameter for the aggregate production function used in the above exercise, it becomes imperative to determine the value of the parameter that should be used for the aggregation. Using cross-country data, I plot the logarithm of relative wages against the logarithm of the ratio of the two types of labor and find that the slope, which provides an estimate of the substitution parameter for this particular aggregation, varies systematically with GDP per worker: low income countries have a steeper slope than high income countries.[5] In other words, the relation between relative wages and relative endowments of skilled and unskilled labor varies systematically across countries.[6] This evidence suggests that aggregation of the two types of labor into a single factor of production using a common substitution parameter will not be able to match this systematic cross-country difference in the relationship between relative wages and relative endowments of skilled and unskilled labor.

A natural question to ask, then, is whether using aggregate production functions that allow for skilled and unskilled labor to be used as separate inputs for growth accounting would lead to conclusions that differ from those obtained by Hall and Jones (1999). The two-level or nested-CES class of aggregate production functions provide a generalization of the aggregation used by Hall and Jones.[7] Based on estimates obtained using data for the US (Krusell et al., 2000) and cross-country panel data (Duffy et al., 2004), the literature on capital-skill complementarity has argued in favor of one nesting of this class of production functions. I employ this preferred APF for the growth accounting exercise and investigate whether doing so results in significant changes in the importance of TFP in explaining cross-country income differences.

When aggregating the two types of labor into a single input, for the Hall and Jones growth accounting exercise, the labor share of income is assumed to be constant across countries while country-specific relative wages of skilled and unskilled labor are used to compute the relative efficiency of the two types of labor. To ensure comparability of results with the previous exercise, for the preferred variant of the nested-CES APF, I use estimates of the substitution parameters from Duffy et al. (2004) and

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[1] The debate whether factors of production or TFP contribute more to explaining differences in incomes across countries is not only important for designing policies to reduce these large differences but also for examining whether exogenous (augmented Solow model used by Mankiw et al., 1992) or endogenous growth models should be used for understanding such differences. For a detailed discussion see Klenow and Rodríguez–Clare (1997).

[2] Given the lack of consensus for how skilled labor should be defined, all the analysis in the paper is based on two different definitions of skilled labor. Definition 1 defines skilled labor as those who have completed primary level of schooling while definition 2 defines skilled as those who have completed secondary level of schooling.

[3] When aggregating skilled and unskilled labor to construct human capital, both Klenow and Rodríguez–Clare (1997) and Hall and Jones (1999) assume perfect substitutability between the two types of labor.

[4] A low value for the parameter (a low elasticity of substitution) implies large differences in human capital stocks across countries, and this lowers the differences in TFP required to account for cross-country income differences.

[5] This systematic cross-country difference holds for both the definitions of skilled labor that I consider.

[6] A similar systematic difference in the relation between relative wages and relative endowments between low income and high income countries has been documented by Acemoglu (2003). Investigating the role of capital-skill complementarity, Chmelarova and Papageorgiou (2005) and Henderson (2005) find similar cross-country systematic differences in the substitutability between capital and the two types of labor.

[7] Nested-CES production functions were first introduced by Sato (1967) and have recently been used to evaluate the role of capital-skilled complementarity (see, for example, Duffy et al., 2004, Krusell et al., 2000 among others).