WP/00/104

IMF Working Paper

The Impact of Intersectoral Labor Reallocation on Economic Growth

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INTERNATIONAL MONETARY FUND

 WP/00/104

IMF Working Paper

Research Department

The Impact of Intersectoral Labor Reallocation on Economic Growth

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Authorized for distribution by Eduardo Borensztein

June 2000

Abstract

This study seeks to explain economic growth differences in an aggregate production function framework, where labor reallocation from agriculture to modern sectors influences labor efficiency growth. The econometric analysis uses a panel of 65 countries over 1960-90. The results highlight: (a) the differences in labor reallocation impact on growth, controlled for using the intersectoral wedge in labor productivities; (b) the significance of labor reallocation effects, even after controlling for capital accumulation, initial conditions, and country effects; (c) the role of slow labor reallocation in explaining the dummy variable for Sub-Saharan Africa; (d) the role of initial education levels in explaining differences in labor reallocation rates.

JEL Classification Numbers: O11, O14, O40

Keywords: Growth, labor reallocation, labor efficiency, education

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[1] I thank Jean-Claude Berthelemy, Francois Bourguignon, Daniel Cohen, Antoine d'Autume, Thierry Magnac, and Jean-Marc Robin for useful comments on earlier drafts of this paper. All remaining errors are mine only.

Contents

I. Introduction

What is the impact of labor reallocation on measured economic growth rates? In particular, to what extent do "reallocation effects" contribute to the explanation of faster or slower than average growth episodes? This study seeks to answer these questions using panel data for 65 countries during 1960-90.

In the growth and development literature, reallocation effects are mostly analyzed in the framework of two-sector growth models, where economic growth is the weighted average of value added growth in each sector (Robinson, 1971, Feder, 1986, and Dowrick and Gemmel, 1991). Empirically, these studies use cross-section or pooled OLS regressions of output growth on investment and other variables, including indicators of sectoral changes (generally the changes in sectoral shares in GDP or the labor force). Investment rates are used to proxy for capital accumulation rates in the growth accounting equation estimated. The oldest studies analyze relatively small samples of countries whereas the most recent one by Dowrick and Gemmel (1991) uses a much larger sample. Also, the older studies assume that the gain from a given labor reallocation remains constant over time, whereas Dowrick and Gemmel (1991) show that it tends to decrease over time as a country's level of development increases. Previous studies tend to overestimate the contribution of reallocation effects on growth by not taking this into account. Dowrick and Gemmel's results suggest that the reallocation of labor from agriculture to industry and services has accounted for 25 % of the 0.8 percentage points growth differential between high and low-income economies over 1960-73.

In this study, we focus on the effect of labor reallocation on growth in the simpler framework of an aggregate growth model, "augmented" with human capital. The aggregate human capital-augmented growth model is the framework most widely used in the recent growth literature (for example, Mankiw, Romer, and Weil, 1992, Benhabib and Spiegel, 1994). The results obtained are thus directly comparable and show how conventional estimates are adjusted when accounting for reallocation effects. Following Cho (1994), Mulligan and Sala-i-Martin (1994), and Sarel (1995), we introduce reallocation effects by measuring the labor input in efficiency units rather than in number of workers. The intersectoral reallocation of labor influences labor efficiency growth, and consequently output per worker growth, as soon as labor efficiency differs between sectors.

An intersectoral wedge in labor efficiency can result from different sources: (a) the normal functioning of the labor market, compensating unobserved sectoral differences in education ; (b) institutional influences such as presence of unions or minimum wages laws that apply only to certain industries, which imply real wage rigidity and a rationing of employment in the industries concerned ; (c) efficiency wages payed in certain industries, i.e. the employers take into account the possibility of increasing their profits by paying workers at a rate higher than that of the market to maximize the effort they provide ; or any combination of these three influences.

As this study focuses on the macroeconomic effects of labor reallocation, microeconomic factors that can explain the gap in average labor efficiency between sectors are deliberately left unspecified . However, following Dowrick and Gemmel (1991), differences across countries and periods in that gap are taken into account when estimating the aggregate growth equation. The indicator used to this effect is the average labor productivity in one sector relative to the other. Furthermore, the use of panel data allows this study to account for unobserved differences in productivity growth that were overlooked in previous cross-section studies. Cross-section results may overstate the (partial) correlation between labor reallocation and economic growth, if that correlation stems from unobserved factors that cause both labor reallocation and economic growth. Through the inclusion of country effects in the growth equation, panel estimates are robust to this missing variables bias.

Also, unlike previous studies of the labor reallocation-growth relationship, our study uses direct measures of physical capital growth rates rather than proxying for them using investment rates, and it controls for human capital differences, in the form of education growth rates and initial levels.

Our main results can be summarized as follows: (a) the intersectoral wedge in labor efficiency varies between countries and periods and cannot be treated as a constant parameter as in most previous studies ; (b) estimated labor efficiency has increased in most economies, although it has decreased in those countries experiencing strong enough reductions in their intersectoral efficiency differential ; (c) the slower than average rate of increase of productivity in Africa is fully explained by the slow rates of labor reallocation observed in the nations of this continent ; (d) reallocation effects are a significant explanatory factor of growth differences across countries, although their contribution is lower than suggested by previous studies which did not take into account country effects ; specifically, their contribution accounts for about 15% of the growth differential relative to the mean of fast- and slow-growth countries in our sample ; (e) the contribution of labor reallocation to productivity growth is at least partly attributable to more fundamental causes, including the initial level of education of the labor force and a high rate of capital accumulation.

Overall our results highlight a main channel through which initial education and labor market flexibility matter for growth: by promoting a faster reallocation of labor and hence a faster growth rate of productivity. Investment influences growth both directly - through higher capital accumulation - and indirectly - through faster labor reallocation. In terms of policy implications, our results thus stress the importance of an educated labor force, an environment conducive to investment, and possibly institutional reforms that increase labor market flexibility in those countries where real wage rigidities due to institutional factors are present.

The paper is organized as follows. Section II presents the model. Section III presents the estimation results and their implications. Section IV concludes.

II. THE MODEL

We suppose that in each economy, the workers are employed in two sectors, 1 and 2, the sectoral composition of the labor force at each date being given by the shares of labor in each sector (b_1, b_2). Denoting β_i the number of efficiency units of labor possessed by the average person employed in sector i, the average labor efficiency in each economy is:

$$l = \beta_1 b_1 + \beta_2 b_2, \tag{1}$$

or,

$$l = \beta_1 + (\beta_2 - \beta_1) b_2. \tag{2}$$

It is clear that if $(\beta_2 - \beta_1) > 0$, in other terms if the average worker in sector 2 is marginally more productive than the average worker in sector 1, the economies where the share of workers employed in sector 2 is higher will have a labor efficiency greater than average. A labor reallocation from sector 1 to sector 2, by its positive effect on l, will contribute to the growth of GDP per worker, for a given intersectoral wedge in labor efficiency $(\beta_2 - \beta_1)$.

In practice, sector 2 is associated with industry and services and sector 1 with agriculture. This division of production in agricultural and industrial goods seems the most relevant for the experience of most countries, where the structural change of the last four decades is mainly characterized by a massive transfer of labor from agriculture to industry and services (Dowrick and Gemmel, 1991). Moreover, existing studies show that the assumption of a marginal labor productivity gap between services and the rest of the economy (Cho, 1994) or between services and industry (Dowrick, 1989) is rejected empirically, contrary to that of a marginal labor productivity gap between agriculture and the rest of the economy (Dowrick, 1989, Dowrick and Gemmel, 1991) or between industry and the rest of the economy (Feder, 1986 and Cho, 1994).

The intersectoral labor efficiency gap $(\beta_2 - \beta_1)$ can result from several factors, including unobserved sectoral differences in average education. Case studies of individual countries (in particular the United States) show that the log of wages is approximately linearly related to years of schooling, so that $w_s = w_0 e^{\beta s}$, where w_s is the wage rate of an individual with s years of schooling and β is the coefficient of schooling in a Mincerian wage regression (see Willis, 1986 for a survey). If the distribution of schooling in each sector is simply translated to the right as the average number of years of schooling increases, we have $w_j = w_0 e^{\beta \mu_j + \varepsilon_j}$, where w_j is the average wage in sector j, μ_j is the average number of years of schooling in sector j, and ε_j depends on other aspects of the distribution but is independent from the mean (see Mulligan and Sala-i-Martin, 1993). Consequently, the gap $(\beta_2 - \beta_1)$ may simply reflect a gap $(\mu_2 - \mu_1)$ in average education in favor of sector 2. Empirical evidence that the average level of education is lower in agricultural sectors than in non-agricultural sectors exists, at least for developed countries (Prais, 1995).

Institutional influences can also explain the gap $(\beta_2 - \beta_1)$. Suppose that the real wage in sector 2 is fixed at a level higher than equilibrium due to institutional forces, which in practice may include unions, governments (for example through a legislation on the minimum wage which applies only to modern sector jobs), or any combination of these different forces. Employment in sector 2 is thus determined by fixed production factors and by the exogenous real wage rate, while workers who are not employed in sector 2 are payed at their marginal productivity in the rest of the economy. In such a dual economy à la Lewis (1954), wages, even adjusted for differences in skills, tend to be higher in sector 2 than in sector 1, and all the more so that the level of the real wage w_2 is high in sector 2. The gap $(\beta_2 - \beta_1)$ results in this case from the fact that employment is rationed in sector 2 by a real wage higher than equilibrium, rather than from sectoral differences in education. Empirically, dualism appears to characterize labor markets in developing countries (Tidrik, 1975, Fields, 1980, and Squire, 1981).

Finally, the gap $(\beta_2 - \beta_1)$ can result from the payment of an efficiency wage in sector 2. In other terms, employers in sector 2 find that they can increase their profits by paying workers wages higher than in the rest of the economy (see Akerlof and Yellen, 1986, for a survey of the literature on efficiency wage models). Again, employment in sector 2 is rationed by the efficiency wage and if workers who are not employed in sector 2 are payed at their marginal productivity in the rest of the economy, the wages, even adjusted for differences in skills, tend to be higher in sector 2 than in sector 1.

In individual case studies, relative wage rates are observed at the sectoral level, so that l may be computed directly from expression (1). For a large panel of countries such as that considered here, detailed information on wages is not available. A possible approach, which is adopted here, consists in parametrizing the gap $(\beta_2 - \beta_1)$. The easiest way to do so is to assume it to be constant:

$$\beta_2 - \beta_1 = \theta \tag{3}$$

where θ is a positive parameter. Assumption (3) is justified if, for example, the gap $(\beta_2 - \beta_1)$ essentially results from sectoral differences in education and the average education levels grow at the same rate in both sectors. Another theoretical justification of assumption (3) is proposed by Ahumada and Sanguinetti (1995). Their approach consists in reformulating a sectoral disequilibrium model à la Feder (1986) in terms of the modern theory of endogenous growth. In the resulting theoretical model, the intersectoral labor productivity wedge remains constant over time because of an endogenous growth of productivity in the modern sector.

Even if assumption (3) holds within each country, it appears too restrictive when imposed to a cross-section of countries. Even if in each economy, the intersectoral productivity gap stays constant over time, there is no reason why it should be the same in all countries of the cross-section. Taking the average labor productivity gap between sectors (agriculture and industry) as a proxy for the marginal labor productivity gap between sectors, Dowrick and Gemmel (1991) find that it tends to decrease with the level of development: richer economies have on average closer sectoral labor productivities than poorer economies. A possible explanation is that (unobserved) sectoral education differences tend to diminish with development.

Following an argument similar to that developed by Bourguignon and Morrisson (1995), the average labor productivity in sector 2 relative to sector 1, denoted $Rlp = y_2/y_1$ where y_j represents the value added per worker in sector j, can proxy for the intersectoral wage gap if it results from a real wage in sector 2 fixed at a level higher than equilibrium, rather than from sectoral differences in education. Suppose, for example, that both sectors employ specific fixed factors. In sector 2, employment is a decreasing function of w_2 and labor productivity y_2 an increasing function of w_2 and of the fixed factors available in this sector. If, moreover, it is assumed that all workers who are not employed in sector 2 are employed in sector 1, employment in sector 1 is an increasing function of w_2 and the labor productivity y_1 a decreasing function of w_2 and of the fixed factors available in that sector. Consequently, Rlp is an increasing function of w_2 and of the fixed factors in sector 2, and a decreasing function of the fixed factors in sector 1.

Given the observations above, an alternative way of parametrizing the gap $(\beta_2 - \beta_1)$ is:

$$(\beta_2 - \beta_1) \quad = \quad \theta + \widetilde{\theta} Rlp, \tag{4}$$

where $\theta, \widetilde{\theta}$ are positive parameters that are supposed to be identical in all countries and periods. The expression of average labor efficiency becomes:

$$l \quad = \quad \beta_1 + \theta b_2 + \widetilde{\theta}\widetilde{b}_2, \tag{5}$$

where $\widetilde{b}_2 = Rlp * b_2$ represents the share of labor in sector 2, weighted by its average productivity.

The parameter β_1 is assumed to be constant across countries and periods. In other words, the efficiency of a worker in sector 1 is assumed not to differ significantly between countries and periods. It would be the case if, for example, labor in sector 1 was unskilled. Under this assumption, the evolution of l essentially reflects the schooling effort of workers in sector 2 or the share of that sector in the labor force, when employment there is rationed by an above equilibrium real wage.

To normalize the labor efficiency index, average labor efficiency in the sample is set to 1, following Sarel (1995), so that :

$$1 \quad = \quad \beta_1 + \theta m_2 + \widetilde{\theta}\widetilde{m}_2 \tag{6}$$

denoting $m_2, \widetilde{m}_2$ the means of $b_2, \widetilde{b}_2$ for the sample. The expression for l becomes :

$$l \quad = \quad 1 + \theta d_2 + \widetilde{\theta}\widetilde{d}_2 \tag{7}$$

where $d_2, \widetilde{d}_2$ are the differences between $b_2, \widetilde{b}_2$ and their respective means. The growth of labor efficiency over a given period can then be measured by taking log first differences and using the approximation $\ln(1+u) \simeq u$, which is valid here, since $d_2, \widetilde{d}_2$, being differences from their mean, cannot be very different from zero:

$$\Delta \ln l = \theta \Delta d_2 + \widetilde{\theta}\Delta\widetilde{d}_2 = \theta\Delta b_2 + \widetilde{\theta}\Delta\widetilde{b}_2. \tag{8}$$

Note that in the case of labor reallocation from sector 1 to sector 2 ($\Delta b_2 > 0$) the contribution of the first term $\theta\Delta b_2$ is always positive. But the contribution of the second term, $\widetilde{\theta}\Delta\widetilde{b}_2$, can be positive, zero or negative depending on whether $\widetilde{b}_2$ increases, remains constant or decreases between the beginning and the end of the period, i.e. whether the growth of b_2 is stronger, equal to, or less than the decrease in Rlp between the beginning and the end of the period. The net effect of reallocation on labor efficiency l (and consequently of per worker GDP growth) is not necessarily positive, contrary to what most previous analyses of the reallocation-growth relation imply (for example Feder, 1986).

Aggregate production is assumed to be given by a constant returns to scale production function. Production factors considered are physical capital, human capital (years of schooling in the labor force), and labor (adjusted for its average efficiency). In intensive form and imposing the usual Cobb-Douglas structure, the expression of GDP per worker can be written:

$$y \quad = \quad Ak^{\alpha}h^{\beta}l^{1-\alpha-\beta}, \tag{9}$$

where y is GDP per worker, A is the level of total factor productivity (TFP), k is physical capital per worker, h is human capital (education) per worker, and l is the index of labor efficiency defined above. Taking logs and first differences, we obtain an equation for the growth rate of per worker GDP :

$$\Delta \ln y \quad = \quad \Delta \ln A + \alpha \Delta \ln k + \beta \ln h + (1-\alpha-\beta)\Delta \ln l. \tag{10}$$

Because of the term $(1-\alpha-\beta)\Delta \ln l$, this equation differs from the standard growth accounting equation. Substituting $\Delta \ln l$ by its approximation $\theta\Delta b_2 + \widetilde{\theta}\Delta\widetilde{b}_2$, it can be seen that the growth rate depends on two additional factors: the growth of relative employment and of labor efficiency in sector 2.

The rate of growth of TFP, $\Delta \ln A$, is assumed to have four components, the three first ones reflecting conventional hypotheses on the growth process of TFP[2] and the last one - or country effect - summarizing the effect of all omitted variables. The four components are: a) an exogenous component ϕ_t, common to all countries over a given period ; b) a technological catch-up effect, $\lambda \ln y$, where $\lambda < 0$ if countries initially less advanced technologically tend to catch-up with countries which are initially more advanced, the initial technology level being proxied by GDP per worker ; c) a human capital level effect, $\mu \ln h$, where $\mu > 0$ if an initially higher human capital fosters the technological catch-up process, or contributes through other channels to the growth of TFP ; and d) an unobserved country-specific effect, ν_i, that captures all residual unobserved influences on TFP growth:

$$\Delta \ln A = \phi_t + \lambda \ln y + \mu \ln h + \nu_i \tag{11}$$

The final growth equation obtained allows to test the different assumptions made on the growth process of GDP per worker:

$$\begin{aligned} \Delta \ln y \quad = \quad & \alpha \Delta \ln k + \beta \ln h + (1 - \alpha - \beta)\theta \Delta b_2 + (1 - \alpha - \beta)\widetilde{\theta} \Delta \widetilde{b}_2 \\ & + \mu \ln h + \lambda \ln y + \phi_t + \nu_i. \end{aligned} \tag{12}$$

If the parameters α, β, θ, $\widetilde{\theta}$, μ, λ, ϕ_t are, as assumed, identical for all countries and, except for ϕ_t, constant between periods, the model predicts that the rate of growth per worker is a linear function of the following variables: the growth of physical capital per worker, the growth of human capital per worker, the change in the relative number of workers in sector 2 and/or their average efficiency, initial conditions (initial human capital and productivity levels), and the exogenous TFP growth (period and country effects).

III. Empirical results

The initial sample includes 83 developing and advanced countries over the period 1960-90. Each output, capital, and education growth observation is a five-year average (1961-65, 1966-70, 1971-75, 1976-80, 1981-85, and 1986-90), to smooth short-run fluctuations. The panel is unbalanced i.e. some observations are missing, in particular for the education, relative labor productivity, and employment share variables. For each variable, there are between one and six observations per country. When the education (resp. reallocation) variables are included, the sample is restricted to 75 (resp. 65) countries, and a total of 422 (resp. 309)

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[2] Dowrick (1989), for example. The variable $(Y_2/Y)_{t-1}$ was also introduced to test the hypothesis of a production structure effect, i.e. a systematic difference in rates of productivity growth between sectors, but the coefficient obtained was not significantly different from zero in any of the regressions. There does not appear to be a systematic productivity growth difference in favor of sector 2.

observations. The data and the list of countries (Table A1) are presented in more detail in the Appendix.

A. Estimation results

The results are presented in Table 1. Regressions were run using OLS (with fixed effects) and the White estimation method (variance-covariance matrix adjusted for heteroskedasticity). Regression (1) only includes as explanatory variables the growth rates of physical and human capital, the initial productivity, period dummies, and country dummies (fixed effects). The F-test for presence of fixed effects shows that they are jointly significant at the 1 % level. The Hausman specification test shows that the fixed effects specification is preferred to the random effects one. The regression explains about 54 % of the within-country variation of growth rates over the period.

The coefficient of physical capital is about 0.45, which is relatively high compared to the share of this factor in national income (about 0.3-0.4). In contrast, the coefficient of human capital (education) is not significantly different from zero at the usual significance levels. This last result is similar to that obtained by other studies which have used within-estimation rather than pure cross-section estimation (see for example Islam, 1996). Apparently, the expected positive effect of human capital accumulation on growth cannot be put in evidence in the time-series dimension: a possible reason may be that the horizon considered is not sufficiently long, whereas in the cross-section dimension there is sufficient variation across countries. The negative coefficient on the initial productivity, $\ln y_{t-1}$ obtained can be interpreted as a technological catch-up effect of countries that are initially less advanced. It is significantly different from zero at the 1 % level. The initial level of human capital (education), $\ln h_{t-1}$ in contrast has an estimated coefficient which is not significantly different from zero at conventional levels.

Regression (2) introduces the two labor reallocation variables, Δb_2 and $\Delta \widetilde{b}_2$. Their estimated coefficients are respectively 0.91 and 0.056 and both are significantly different from zero, at least at the 5 % level of significance. The positive sign of Δb_2 lends empirical support to the assumption of an intersectoral gap in average labor efficiency in favor of sector 2. Note that if $\Delta \widetilde{b}_2$ were not included, regression (2) would be of the type generally estimated in the empirical study of the relationship between labor reallocation and growth (see for example Cho, 1994). It would impose the restriction that the effect of reallocation on growth is identical for all countries and periods. Regression (2) however also introduces the second reallocation variable, $\Delta \widetilde{b}_2$, to test the assumption that the effect of reallocation on growth depends on the magnitude of the productivity gap between sectors, proxied by Rlp. The estimated coefficient of $\Delta \widetilde{b}_2$ is indeed significantly different from zero at the 1 % level of significance. The usual restriction imposed in previous studies of the reallocation-growth relation is thus rejected by the data: the average labor efficiency wedge between agricultural and non-agricultural sectors cannot be treated as a constant parameter. It varies with Rlp between countries and periods.

Table 1. Per Worker Growth Regressions, 75 Countries, 1960-90

Variable	(1)	(2)
Capital per worker growth	0.445 (7.16)***	0.409 (5.46)***
Education growth	-0.0553 (-0.43)	0.106 (0.67)
Initial education	-0.00556 (-1.01)	-0.00281 (-0.369)
Initial GDP per worker	-0.0406 (-4.65)***	-0.0361 (-3.57)***
Change in labor share in sector 2		0.912 (2.08)**
Change in labor share in sector 2 weighted by Rlp		0.0562 (3.93)***
1966-70	0.00971 (2.77)***	0.0111 (1.99)**
1971-75	0.00679 (1.53)	0.00826 (1.22)
1976-80	0.0126 (2.39)**	0.0142 (1.84)*
1981-85	0.00523 (0.82)	0.00689 (0.77)
1986-90	0.0203 (3.38)***	0.0204 (2.36)**
F-test of OLS vs. FE (P-value)	0.0001***	0.0243**
Hausman test of RE vs. FE (P-value)	0.0001***	0.0400**
Adjusted R-squared	0.536	0.546
Observations (countries)	422 (75)	309 (65)

Note: t-statistics in parentheses.
* significant at the 10 % level; ** at the 5 % level ; *** at the 1 % level.

Adding the reallocation variables in regression (2) leads to a significantly better adjustment: the adjusted R-squared increases from 0.536 to 0.546. Country fixed effects are jointly significant in regression (2), as shown by the F-test. As in regression (1), the Hausman test leads to reject the random effects specification in favor of a fixed-effects specification. The main change is a decrease in the point-estimate of the coefficient of $\Delta \ln k$ from 0.445 to 0.409 (the standard errors however do not allow to reject the hypothesis that the coefficient is the same in both regressions). This could be explained by a positive correlation between speed of labor reallocation and capital per worker growth, which is intuitively plausible: if non-agricultural sectors are more capital-intensive than agriculture, capital per worker growth leads to the expansion of these sectors, and thus the growth of relative employment in these sectors. Omitting the labor reallocation variable in regression (1) then biases upward the estimated coefficient of physical capital accumulation.

We now investigate an issue which has been very prominent in the recent growth literature: the slower than average productivity growth of countries in Sub-Saharan Africa and Latin America. Specifically, we examine whether reallocation effects may account for regional growth differences unexplained by factor accumulation and initial conditions. In order to do so, we adopt a two-step method. First, we compute total factor productivity (thereafter, TFP) growth using our estimates of human and physical capital coefficients in Table 1, regression (2). Second, we regress this estimate of TFP growth on potential determinants: initial education and GDP per worker, reallocation variables, period dummies, and regional dummies to test for unexplained regional effects. We include reallocation variables only in a second stage so as to test whether they can account for regional differences in TFP growth unexplained by initial conditions.

Regression (1) in Table 2 shows the results of regressing TFP growth on just the conventional determinants: initial education and GDP per worker levels, period dummies, and regional dummies.[3] The coefficients on the African and Latin American dummies are negative and significantly different from zero at the 5 % level at least. A dummy for oil exporters also has a negative and statistically significant coefficient, albeit only at the 10 % level of significance.

Regression (2) then adds the reallocation variables. They both enter positively and with coefficients that are significant at least at the 5 % level, confirming the result in Table 1 (the difference here is that we do not account for country effects, but only for regional effects). The effect on the African dummy coefficient is striking: the coefficient becomes insignificant at the 10 % level. The coefficients of Latin American and oil exporters dummies in contrast are unaffected. The relatively weak rate of expansion of non-agricultural employment thus appears to account for the systematic TFP growth gap between Sub-Saharan Africa and other regions, while it fails to account for the slower than average Latin American growth experience.

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[3] Only those that were statistically significant at conventional levels are included.

Table 2. TFP Growth Regressions, 75 Countries, 1960-90

Variable	(1)	(2)
Initial education	0.00654 (3.25)***	0.00534 (2.46)**
Initial GDP per worker	-0.00198 (-2.25)**	-0.000441 (-0.44)
Change in labor share in sector 2		0.759 (2.38)**
Change in labor share in sector 2 weighted by Rlp		0.0553 (3.54)***
1966-70	0.00230 (0.76)	0.00400 (1.00)
1971-75	-0.00822 (-2.66)***	-0.00576 (-1.39)
1976-80	-0.00767 (-2.20)**	-0.00418 (-0.888)
1981-85	-0.0212 (-6.68)***	-0.0168 (-3.74)***
1986-90	-0.00707 (-2.24)**	-0.00294 (-0.72)
Sub-Saharan Africa	-0.00893 (-2.34)**	-0.00614 (-1.54)
Latin America	-0.00897 (-3.70)***	-0.00913 (-3.45)***
Oil Exporter	-0.0135 (-1.88)*	-0.0138 (-1.88)*
Adjusted R-squared	0.199	0.259
Observations (countries)	422 (75)	309 (65)

Note: t-statistics in parentheses.
* significant at the 10 % level; ** at the 5 % level ; *** at the 1 % level.

Table 3. Labor Reallocation Regressions, 74 Countries, 1960-90

Variable	(1)	(2)
Capital per worker growth	0.0230 (2.84)***	0.509 (2.32)**
Education growth	-0.0134 (-0.62)	-0.683 (-1.38)
Initial education	0.00199 (2.43)**	-0.00371 (-0.19)
Initial GDP per worker	-0.00110 (-0.94)	-0.0215 (-3.97)***
1966-70	-0.000200 (-0.38)	0.0310 (0.97)
1971-75	-0.000961 (-1.45)	-0.00873 (-0.39)
1976-80	-0.00123 (-1.56)	-0.0247 (-1.12)
1981-85	-0.00116 (-1.38)	-0.0434 (-2.05)**
1986-90	-0.00147 (-1.75)**	-0.0205 (-0.94)
Constant		0.194 (4.51)***
F-test of OLS vs. FE (P-value)	0.0000***	0.4835
Hausman test of RE vs. FE (P-value)	0.0021***	0.8395
Adjusted R-squared	0.497	0.126
Observations (countries)	416 (74)	309 (65)

Note: t-statistics in parentheses.
* significant at the 10 % level; ** at the 5 % level ; *** at the 1 % level.

Figure 1. Labor Efficiency Index, 65 Countries, 1965-90

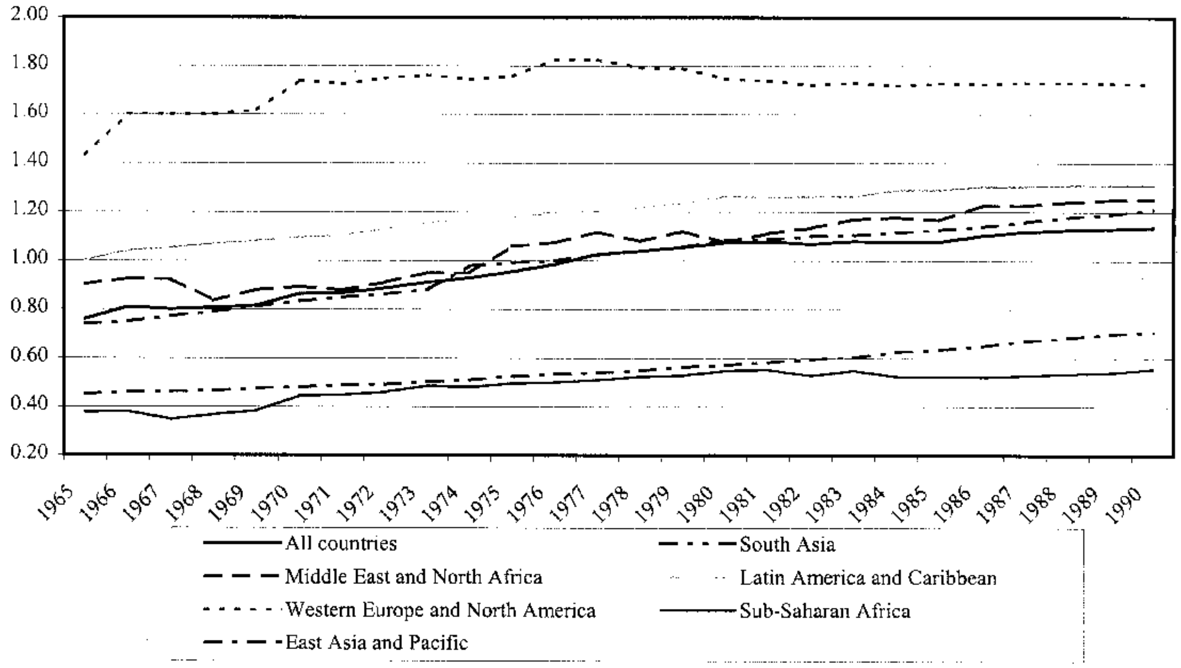
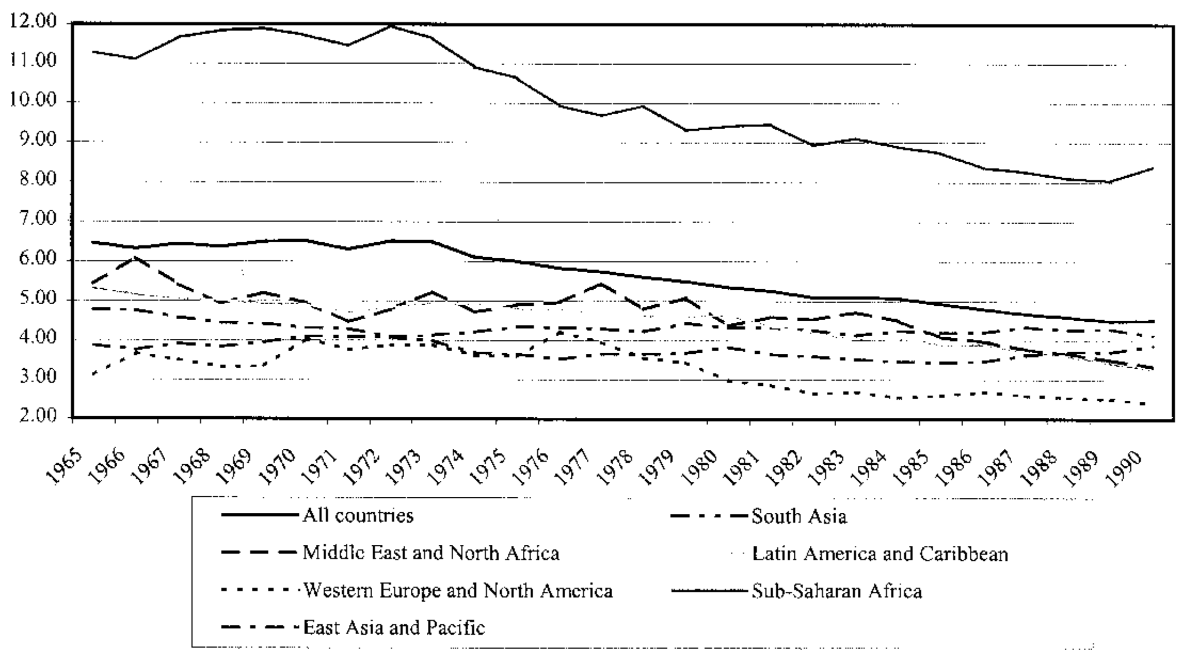


Figure 2. Relative Labor Productivity in Non-Agricultural Sectors
65 Countries, 1965-90



At this stage, an issue that is especially important in terms of the interpretation and policy implications of our results is to what extent they capture a causal effect of labor reallocation on growth. It may be that the same variables which potentially influence growth - physical and human capital accumulation, initial conditions - also influence the pace of labor reallocation that can be achieved in a given country. In other words, labor reallocation may not be exogenous, as we have assumed so far, but at least partially endogenous. It would be driven, at least partly, by the same fundamental factors that drive growth in the neoclassical framework: factor accumulation and initial conditions. In the extreme, when these factors fully account for differences in speed of labor reallocation across and within countries, the reallocation of labor should be seen only as a channel through which more fundamental factors affect growth rates, rather than in itself a fundamental engine of growth. To examine this issue, we regress our two labor reallocation variables, Δb_2 and $\Delta \widetilde{b}_2$, on the same growth determinants that are considered in the regressions presented in Table 1. The results appear in Table 3.

Regression (1) shows that the two most significant factors influencing the variation of Δb_2 across and within countries are physical capital accumulation and the initial education level of the labor force. Both variables are significant at the 1 % level in the fixed-effects specification estimated (the F-test shows that fixed effects are jointly significant in the regression and the Hausman test rejects the random effects specification in favor of the fixed effects one).

The result is particularly interesting in suggesting one channel through which an initially high level of education has a positive and significant impact on productivity growth: a more educated labor force promotes a faster reallocation of labor. In other words, although there is no evidence of a direct significant impact of higher initial education levels on TFP growth rates, education still has an indirect influence on TFP growth through its impact on the intersectoral labor reallocation process.

Physical capital accumulation appears to have both a direct and an indirect influence on GDP growth. Its indirect influence is to allow the expansion of relative employment in more capital-intensive, productive, sectors, thus contributing to the observed reallocation effect.

The conclusion is that the impact of Δb_2 on growth evidenced in Table 1 reflects at least partially an indirect effect of physical capital investment and the initial education level rather than a pure reallocation effect. Nevertheless, the fact that Δb_2 is significant in a regression that already accounts for physical capital accumulation and initial education shows that there is a reallocation effect that is not entirely accounted for by higher investment and initial education.

Concerning $\Delta \widetilde{b}_2$, regression (2) in Table 3 shows physical capital accumulation and the initial productivity level (GDP per worker) to be the main determinants of the variation of this variable across countries and periods (this time the pooled OLS results are reported, as the F-test cannot reject the hypothesis that fixed effects are jointly insignificant). We can thus generalize the preceding conclusion for Δb_2 by saying that the impact of reallocation variables on growth evidenced in Table 1 reflects at least partially an indirect effect of physical capital investment and initial conditions (both education and productivity levels) rather than a pure reallocation effect. This should be borne in mind when drawing implications and in particular policy conclusions from our results.[4]

B. Implications

Contribution of reallocation to the growth of labor efficiency

Under our assumption of constant returns to scale, the value of the labor coefficient can be derived from the values estimated for the coefficients of physical and human capital: $(1 - \alpha - \beta) = 0.485$. The estimated coefficients of Δb_2 and $\Delta \widetilde{b}_2$ (0.912 and 0.0562 respectively) imply $\theta = 1.882$ and $\widetilde{\theta} = 0.116$ and thus:

$$\Delta \ln l = 1.882 * \Delta b_2 + 0.116 * \Delta \widetilde{b}_2. \tag{13}$$

Given the normalization chosen for the index of labor efficiency and the mean sample values $m_2 = 0.544$ and $\widetilde{m}_2 = 2.290$, we obtain:

$$l \quad = \quad 1 + 1.882(b_2 - 0.544) + 0.116(b_2 * Rlp - 2.290), \tag{14}$$

which allows to compute an index of average labor efficiency for each country at each date.

Figures 1 and 2 show the average regional evolutions of the labor efficiency index and one of its two main components, Rlp, from 1965 to 1990.[5] On average, l increases until about 1981 after which it remains stable and only starts to increase again in 1985. Rlp on average is stable until about 1973, after which it decreases regularly. Until about 1973, the increase in l thus reflects the increase in b_2 i.e. the reallocation of labor to non-agricultural sectors, after which the decrease in Rlp (decrease in the productivity gains from a given labor reallocation) starts to temper the labor reallocation-driven growth of average labor efficiency.

Regional differences are quite striking. The region which shows the highest intersectoral wedge in labor efficiency — dualism — is Sub-Saharan Africa: although from 1973 onwards, Rlp does decrease strongly, at the end of the period (1990) it still remains significantly higher than in the other regions (Figure 2). Africa thus stands out as the region

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[4] An instrumental variables approach would be warranted to draw more definite conclusions on the impact of reallocation on growth, but the difficulty of finding relevant instruments for the reallocation variables precludes it here.

[5] Before 1965, data are missing for an important number of countries.

where potential productivity gains from labor reallocation are the highest and remain to be reaped in the 1990s. The slower than average pace of labor reallocation also makes Africa stand out as the region with a slow growth of labor efficiency. There is even evidence of a decrease in the 1980s, when labor is not reallocated fast enough to compensate for decreasing productivity difference across sectors (Figure 1).

As could be expected, the two advanced regions, Western Europe and North America, have the highest level of labor efficiency. But the slow growth of l and even the decrease in the index from 1977 on show that these regions have largely exhausted the potential productivity gains from labor reallocation by the mid-seventies.

The other regions show a fairly stable growth of labor efficiency over the period (Figure 1) although they start from differing initial levels, with Latin America having the highest initial labor efficiency and South Asia the lowest. There is some convergence in labor efficiency between Latin America, East Asia, and Middle East, but South Asia still lags behind at the end of the period (1990).

Growth differences across countries

To what extent does the model explain growth differences across countries, in particular growth rates that are very high or very low relative to average? To answer this question, we decompose the growth rate relative to the mean of the ten fastest and ten slowest countries in our sample for which we have complete data available for 1960-90. Tables 4 and 5 present the values of the variables for each country in each group and the averages for each group. Table 6 presents the decomposition of the growth rate (relative to the mean) for both groups.

It can immediately be seen in Table 4 that neither the growth rate of the level of education nor a technological catch-up effect are likely to explain growth higher than average in the high-growth group. But these countries are characterized, as a group, by an initial human capital level, an accumulation rate of physical capital, and labor reallocation rates (increases in both non-agricultural labor share and labor share weighted by the intersectoral wedge in labor productivities), higher than the sample mean. This fast-growing group is dominated by East Asian countries - seven of them are included - and the remaining three are fast-growing Western European countries (Portugal, Spain, and Greece). Except for Indonesia, Singapore, and China, all countries in the group started out with a higher than average education level of the labor force. Korea and Malaysia stand out as having the fastest pace of labor reallocation (the labor share in non-agricultural sectors increases by almost 1.5% per year on average over the period 1960-90). When the reallocation variable is weighted by relative labor productivity, Thailand stands out as having particularly strong productivity gains from a given labor reallocation, with Korea, Japan, China, and Indonesia also gaining strongly, albeit significantly less than Thailand.

Table 4. Averages for Ten High-Growth Countries, 1960-90

Country	GDP per worker growth	Capital per worker growth	Education per worker growth	Labor reallocation	Lab. Realloc- (weighed by Rip)	Education in 1960 (in log)	GDP per worker in 1969 (in log)
Portugal	5.17%	4.38%	2.54%	0.77%	-1.78%	1.18	8.83
Korea	5.03%	8.53%	3.88%	1.44%	3.30%	0.97	8.18
Japan	4.90%	8.11%	0.26%	0.86%	2.68%	2.32	9.75
Singapore	4.77%	9.77%	4.41%	0.23%	-3.22%	0.75	9.19
Thailand	4.49%	6.93%	1.79%	0.66%	7.89%	1.26	6.82
China	3.85%	3.98%	4.13%	0.37%	2.10%	0.50	5.23
Greece	3.85%	5.56%	1.08%	0.97%	0.53%	1.88	8.99
Indonesia	3.39%	5.91%	3.75%	0.65%	3.60%	0.45	6.46
Malaysia	3.39%	6.18%	2.75%	1.32%	-0.19%	0.94	7.95
Spain	3.17%	2.79%	1.84%	0.61%	-7.00%	1.68	9.34
10 high-growth	4.20%	6.21%	2.64%	0.79%	0.79%	1.19	8.07
65 countries	1.61%	2.75%	2.68%	0.54%	-1.30%	0.92	8.09
Differential	2.59%	3.46%	-0.04%	0.25%	2.09%	0.27	-0.01

Table 5. Averages for Ten Slow-Growth Countries, 1960-90

Country	GDP per worker growth	Physical capital per worker growth	Education per worker growth	Labor reallocation	Laobr reallocation (weighed by Rlp)	Education in 1960 (in log)	GDP per woker in 1960 (in log)
Panama	-1.79%	0.33%	2.31%	0.28%	-8.23%	1.44	8.40
Madagascar	-1.57%	-0.15%	3.18%	0.31%	-2.71%	0.65	6.62
Zambia	-1.36%	-1.37%	4.86%	0.30%	-3.93%	0.11	7.18
Ghana	-1.01%	-0.59%	3.89%	0.10%	0.11%	0.27	6.84
Venezuela	-0.94%	-0.18%	3.72%	0.71%	-16.61%	0.87	9.39
El Salvador	-0.41%	1.70%	2.54%	0.85%	-1.48%	0.91	8.32
Senegal	-0.28%	-0.28%	7.32%	0.24%	2.01%	-1.37	7.23
Argentina	0.06%	1.52%	1.29%	0.24%	-1.76%	1.66	9.62
Jamaica	0.22%	0.90%	1.38%	0.56%	-0.79%	1.71	8.06
Netherlands	0.43%	0.92%	0.55%	0.11%	-10.11%	2.09	10.37
10 low-growth	-0.66%	0.28%	3.10%	0.37%	-4.35%	0.84	8.20
65 countries	1.61%	2.75%	2.68%	0.54%	-1.30%	0.92	8.09
Differential	-2.27%	-2.47%	0.43%	-0.17%	-3.05%	-0.09	0.12

For the ten low-growth countries (Table 5) which start from a lower initial level, the growth of the education level is higher than the sample average. This reflects the presence in this group of several countries from Sub-Saharan Africa (Madagascar, Zambia, Senegal, Ghana), which started from a very low level of education in 1960, and experienced extremely high subsequent growth rates of average education levels. Initial GDP per worker is also higher than average in the low-growth countries as a group. This reflects the presence in the group of one advanced country (Netherlands) and a number of Latin American countries (Argentina, Venezuela, El Salvador, Panama) with relatively high initial per worker GDP in 1960.

In the low-growth group of countries, the initial level of education, the rate of accumulation of physical capital per worker, and the rate of labor reallocation (both measures) are lower than the sample mean, characteristics that are exactly the inverse of those of the high-growth group.

Table 6 presents a decomposition of growth differences of these two groups of countries relative to the sample mean. The relative growth rate of per worker GDP in high-growth countries is about 2.6% per year, 55% explained by the relative growth of physical capital per worker, 14% by the net effect of labor reallocation, and 2% by the initial level of GDP per worker. The model predicts that, because of these three factors only, the per worker growth rate of the ten high-growth countries should be higher than the sample mean by 1.8 percentage points. A total of 70% of the growth gap of these countries relative to the mean is explained.

Table 6. Decomposition of Relative Growth Rates, 1960-90

	Ten high-growth countries		Ten low-growth countries	
Observed per worker GDP growth differential	0.0259		-0.0227	
Accounted by:				
Growth of physical capital per worker	0.0142	*55%*	-0.0101	*45%*
Growth of average education level	0.0000	*0%*	0.0005	*-2%*
Labor reallocation	0.0023	*9%*	-0.0279	*7%*
Labor reallocation (weighed by Rlp)	0.0012	*5%*	-0.0001	*8%*
Initial GDP per worker	0.0005	*2%*	-0.0042	*19%*
Explained growth differential	0.0181	*70%*	-0.0171	*75%*
Unexplained growth differential	0.0079	*30%*	-0.0056	*25%*

For the low-growth countries, the average growth rate is lower than the sample mean by about 2.3 percentage points: 45% of this growth gap is due to physical capital accumulation, 15% to the net effect of labor reallocation, and 19% to the initial average labor productivity. Given these three effects, the predicted per worker growth rate in these countries is 1.7 percentage points below the sample mean. Thus, the model explains 75 % of the observed growth gap of these countries relative to the sample mean.

Now, as we have seen earlier, labor reallocation is at least partially endogenous. Thus the net effect quantified in Table 6 is partly attributable to capital accumulation and initial conditions. In particular, the initial level of education of the labor force was identified as a crucial factor determining the pace of labor reallocation achievable by a given country. This initial education effect on growth, though it does not appear explicitly in Table 6 (no direct effect on growth), is subsumed in the labor reallocation effect quantified in Table 6.

IV. Conclusion

The results of this study confirm the importance of labor reallocation from agriculture to industry in explaining differences in growth performances both across and within countries. These countries that reallocate their workers more efficiently over time tend to grow faster, in per worker terms, *ceteris paribus*. Reallocation effects account for the systematic (negative) growth gap of African countries relative to the rest of the sample.

The results obtained also show, however, that the labor reallocation effect on growth depends on factors that are specific to each country and/or period considered. Specifically, they lead to reject a model where the effect of labor reallocation on per worker GDP growth is a constant, against an alternative model where it varies with the average productivity in one sector relative the other.

In most developing countries included in the sample, the net contribution of labor reallocation to growth is positive. It is negative in some countries in periods during which they experience a very strong reduction of the intersectoral wedge in labor productivity — and thus a reduction in the efficiency gains from any given labor reallocation. This is the case for African countries as a group during the 1980s.

A decomposition of the growth rates relative to the sample mean for the ten fastest-growing countries and the ten slowest-growing countries, shows that 70% of the growth differential relative to the mean of high-growth countries is explained by higher than average physical capital accumulation, initial productivity level, and net labor reallocation effect. The net labor reallocation effect alone accounts for 14% of the higher GDP per worker growth of these countries relative to the sample mean. It largely dominates the catch-up effect (lower initial productivity level), which accounts for only 2% of the growth differential.

The same factors also contribute in about the same order of magnitude to the explanation of the growth gap of the slowest-growing countries relative to the sample mean.[6] The contributions of physical capital accumulation, labor reallocation, and initial average labor productivity account respectively for 45%, 15%, and 19% of the observed growth gap of these countries relative to the sample mean. Given the positive contribution of education growth (2% of the observed growth gap), the predicted growth gap of these countries relative to the sample mean represents 75% of the observed growth gap. In this case, the reallocation effect is about the same order of magnitude as the catch-up effect, in contrast to the high-growth countries.

We also find evidence in this study that initial conditions (education levels and productivity levels) and the capital accumulation rates are significant factors constraining the pace of labor reallocation and the productivity gains from labor reallocation achievable by a given country. Our study sheds light on the channels through which these more fundamental factors affect growth: initial education does not appear to have a direct influence on growth, although it does influence it through its positive impact on the pace of labor reallocation achievable by countries ; in contrast, capital accumulation has both a direct impact on output growth by increasing productive capacity and an indirect impact by allowing a faster labor reallocation.

These findings affect both the interpretation of the results — particularly the policy implications — and the directions they suggest for future research. In terms of policy implications, our results suggest that raising education levels in the labor force can have a significant pay-off by allowing countries to achieve quickly a more efficient allocation of labor across sectors of production, even if education increases appear to have no direct effects on growth. In that case, education would contribute to growth more by increasing workers' capacity to be mobile across sectors, rather than by increasing directly their productivity in a given sector. An environment conducive to investment and thus higher capital accumulation rates is also important both directly (volume effect) and indirectly (efficiency effect). Finally, in countries where the allocation inefficiency stems from labor market rigidities, labor market reforms may also play a role in enhancing productivity growth prospects: by increasing real wage flexibility in the most productive sectors, relative employment in those sectors could increase, and the country in the aggregate would benefit from higher productivity growth. The data suggest that in many developing countries, the potential for such productivity gains from labor reallocation is still quite high in 1990 (end of our period), unlike more advanced countries.

In terms of directions for future research, our findings point to the need for a more in-depth study of the reallocation-growth nexus since we found evidence of significant reallocation effects, even after controlling for capital accumulation, initial conditions, and other unobserved factors (in the form of country effects). Also, since labor reallocation variables appear at least partly endogenous, there is a need for more analytical research on how

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[6] The (negative) catch-up effect is relatively stronger though for slow-growth countries.

to endogenize labor reallocation decisions and their impact on the intersectoral productivity gap and on the aggregate growth. Such a model would explicitly feature two (or more) sectors of production, relative prices governing allocation decisions, and would require a departure from the aggregate production function framework. Such an attempt is beyond the scope of this paper but does point to an important and largely overlooked research direction in the growth literature.

Table A1. Country List by Region

Middle East and North Africa	Latin America and Caribbean	Western Europe and North America	South Asia	Sub-Saharan Africa	East Asia and Pacific
Algeria	Argentina	Australia	Bangladesh	Cameroon	Australia
Egypt	Bolivia a/	Austria	India	Cote d'Ivoire	Indonesia
Greece	Brazil	Belgium	Pakistan	Ethiopia a/	Japan
Iran	Chile	Canada a/	Sri Lanka	Ghana	Korea
Israel a/	Colombia	Denmark		Kenya	Malaysia
Jordan	Costa Rica	Finland		Madagascar	Philippines
Morocco	Dom. Rep. b/	France		Malawi	Singapore
Portugal	Ecuador	Iceland		Mali	Thailand
Tunisia	El Salvador	Ireland a/		Mauritius	
Turkey	Guatemala	Italy		Mozambique	
	Guyana a/b/c/	Luxembourg a/ b/		Nigeria	
	Haiti	Netherlands		Rwanda	
	Honduras	New Zealand a/		Senegal	
	Jamaica	Norway		Sierra Leone	
	Mexico	Spain		South Africa b/	
	Nicaragua b/	Sweden a/ c/		Sudan a/	
	Panama	Switzerland a/		Uganda	
	Paraguay	United Kingdom a/		Zambia	
	Peru	United States		Zimbabwe	
	Trinidad and Tobago b/				
	Uruguay				
	Venezuela				

Notes: a/ Rlp missing ; b/ education missing ; c/ b2 missing.

Data

Real GDP in 1995 constant dollars, real value added in agriculture in 1995 constant dollars, total labor force, and the share of the labor force employed in agriculture are extracted from World Bank (1999).

The capital stock in 1987 constant dollars is from Nehru and Dhareshwar (1993).

The average number of years of schooling in the population aged 15 to 64 is from Nehru, Swanson, and Dubey (1995).

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