



WP/00/94

IMF Working Paper

Factor Reallocation and Growth in Developing Countries

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IMF Working Paper

Research Department

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Authorized for distribution by Eduardo Borensztein

June 2000

Abstract

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This paper examines the extent to which developing countries benefit from intersectoral factor transfers by specifying the impact and determinants of sectoral changes and of the degree of dualism (or allocation inefficiency) in a dual economy model. Conditions under which factor reallocation is growth-enhancing are derived. An empirical error-correction equation is estimated for 30 developing countries during 1965-80. Results suggest that labor reallocation effects are especially important in countries with high rates of investment (and thus high rates of labor transfer) and/or at low levels of development (and thus high degrees of dualism).

JEL Classification Numbers: O11, O41

Keywords: Factor reallocation, dualism, growth

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¹I thank Antoine d'Autume, Jean-Claude Berthelemy, Francois Bourguignon, Eve Caroli, Daniel Cohen, Sebastien Dessus, David Dollar, Thierry Magnac, Eswar Prasad, Jean-Marc Robin, and seminar participants at the DELTA-LEA Development Economics Seminar, the University of Evry Macroeconomics Seminar, and the 1997 Annual Conference of the Latin American and Caribbean Economic Association for useful comments on earlier drafts of this paper. All remaining errors are mine only.

	Contents	Page
I.	Introduction	3
II.	Theoretical Framework.....	5
	A. Sources of growth	6
	B. Model assumptions.....	7
	C. Reallocation effects	8
	D. Resource allocation	10
III.	Econometric Specification and Testing	12
	A. Econometric specifications	12
	B. Estimation strategy	15
IV.	Data.....	15
V.	Estimation Results	17
	A. Model estimation.....	17
	B. Sectoral production functions	17
	C. Reallocation effects	19
VI.	Conclusion	22
Tables:		
1.	Region Averages, 1965-80, 30 Developing Countries	24
2.	Regression for Agricultural Labor Productivity Growth.....	25
3.	Estimated Intersectoral Spread in Marginal Labor Productivity	25
4.	Sources of Per Worker GDP Growth	26
Appendices:		
A.	Variables, Definitions, Data Sources.....	27
B.	Country List	27
	References	28

I. INTRODUCTION

The economic development literature has long recognized the role of sectoral changes in growth. In particular, the idea that factor reallocation contributes to total factor productivity growth -and thus to GDP growth- has often been emphasized (Syrquin, 1986). An early work by Robinson (1971) has put this idea into a formal set-up, constituting what he calls a “model of structural change and growth.” In this model, capital and labor reallocation have a positive effect on GDP growth due to the assumption that marginal factor productivity is higher in the non-agricultural sector compared to the agricultural. The empirical results in Robinson (1971), obtained for a sample of 39 developing countries over the period 1958-66, suggest that the contribution to growth of factor transfers is important for developing countries: it is higher than the estimated contributions of reallocation to growth in the United States and Western Europe.

More recent studies of the effect of factor reallocation on growth —Feder (1986), Dowrick (1989), Dowrick and Gemmel (1991)- are based on a similar theoretical framework. At the empirical level, these studies perform similar cross-country regressions where the rate of growth of GDP or per capita GDP is regressed on investment and other variables, including sectoral indicators (usually the changes in the sectoral shares of output and/or labor).

The results of Feder (1986), for a sample of 30 semi-industrialized countries, suggest that a substantial difference has existed during the period 1964-1973 between marginal factor productivity in industrial and non-industrial sectors. Consequently, those countries that pursued an accelerated industrial growth had a tendency —*ceteris paribus*— to grow faster than other countries in the group because the resource allocation came closer to optimal.

Using an approach similar to that of Feder (1986), Dowrick (1989) finds evidence that GDP growth since 1950 has been systematically higher in those OECD countries that have been able to reallocate a greater share of their labor force out of agriculture into industry and services. He infers that the marginal labor productivity in agriculture has been systematically lower than that in the rest of the economy. He finds however no evidence of a difference in marginal labor productivities between industry and services.

The results of Dowrick and Gemmel (1991) suggest that labor reallocation from agriculture to industry (including services) has made a significant contribution to GDP growth : labor reallocation effects explain 25 % of the per capita growth difference of 0.8 percentage points observed between middle-income and high-income economies in their sample during the period 1960-73. Their results clearly reject, like the three studies above, the assumption of equal marginal labor productivities between sectors. But they also show that a model where the intersectoral spread in marginal labor productivities is the same size in all countries is rejected in favor of a model where the spread in marginal labor productivities between sectors varies according to the difference in average labor productivities between sectors (which is the case when sectoral production functions are Cobb-Douglas).

The studies above, however, do not take care of the robustness of their results. Sectoral indicators included as regressors are considered exogenous, although it is plausible that variations in sectoral indicators are at least partly a consequence of GDP growth. A strong simultaneity bias may thus affect regressions where growth is regressed on changes in sectoral variables. It may account for the very strong statistical association found between sectoral change indicators and growth.²

One can also note at least four other shortcomings of studies of structural change and growth.

First, indirect measures of the accumulation rates of physical capital and the labor force growth rate are used (respectively, investment as the share of GDP and the population growth rate). Moreover, human capital growth is usually not taken into account.

Second, relationships between sectoral changes and growth are identified only on the basis of cross-country variation. Country effects are not taken into account, so that the results may reflect an omitted variable bias.

Third, except in the study of Dowrick and Gemmel (1991), the difference in marginal factor productivities between sectors is treated as a constant parameter. This assumption is particularly subject to caution, since the spread in marginal factor productivities between sectors reflects country-specific factors, institutional and others. Dowrick and Gemmel (1991) use as indicator of the intersectoral difference in marginal labor productivities the intersectoral difference in average labor productivities. But the issue of the exogeneity of this latter indicator remains open. Dowrick and Gemmel (1991) indeed note that it varies negatively with the level of economic development (real per capita GDP).

Fourth, most studies interpret the statistically significant association found between sectoral change indicators and growth as reflecting important factor market imperfections in the countries studied, especially the dualism of labor markets.³ The results are not discussed in the light of alternative interpretations (unobserved differences in factor quality across sectors, sector-specific externalities). In particular, the presence of an (unobserved) human capital differential in returns across sectors would generate the same results, even with no labor market disequilibrium.

² See Cho (1994) for an attempt at adjusting for the endogeneity of the sectoral change variable in a cross-section framework, using an instrumental variables method.

³ Some recent studies confirm the presence of (real) wage rigidity in developing countries: see for example, Rama (1998) for CFA countries. This study finds that the most likely candidates to explain real wage rigidity in CFA countries are government pay policies and (possibly) limited competition in product markets rather than distortive labor market policies (e.g. minimum wages).

This paper revisits the relationship between factor reallocation and growth. It attempts to overcome the weaknesses exposed above in a number of ways.

First, direct measures of physical and human capital stocks and of the labor force are used in estimations, allowing us to obtain better estimates of total factor productivity growth. The role of land as an input in the agricultural production function is also taken into account.

Second, panel data estimation is used, rather than cross-section estimation, allowing us to control for country effects.

Third, the resource allocation process is specified for each period, allowing us to endogenize sectoral changes as well as the spread in marginal factor productivities between sectors.

Fourth, the empirical work is based on the relationship that holds between average sectoral labor productivities at the equilibrium of the capital market, rather than on the equation linking growth to structural change. This equilibrium—cointegration—relationship is estimated on a panel of 30 developing countries over the period 1965-80, allowing us to identify the underlying structural model. Estimated parameters are used, together with sectoral data on labor and output to evaluate quantitatively the labor reallocation effects and their contribution to growth.⁴

Finally, although the theoretical framework adopted is that of a dual economy, with real wage rigidity in the modern sector, the results do not hinge on the assumption of a labor market wage differential across sectors. They are consistent with an (unobserved) human capital differential in returns, so that a human capital-weighted labor market equilibrium would hold.

We present in section II the theoretical framework, in section III the econometric specification, in section IV the data, in section V the empirical results. Section VI concludes.

II. THEORETICAL FRAMEWORK

We consider a two-sector dual economy. The modern sector is associated with industry and services and is indexed 0, while the traditional sector is associated with agriculture and is indexed 1. The modern good is taken as numeraire. The relative price of the traditional good is denoted p . We assume that both sectors employ capital and labor inputs, while only agriculture employs land. Finally, we assume that there is perfect capital and labor mobility between the two sectors.

⁴ In the absence of data on sectoral capital stocks and income shares of capital, the capital reallocation effect cannot be quantitatively estimated. Our results allow us nevertheless to state more precisely the conditions under which capital reallocation is growth-enhancing.

GDP (Y) can be expressed as:

$$Y = Y_0 + pY_1 \quad (1)$$

where Y_j is value added in sector j ($0, 1$).

A. Sources of growth

Assuming full employment of resources, and denoting (u_j, l_j) the shares of capital and labor in sector j , the growth rate of GDP can be expressed as:

$$\frac{\dot{Y}}{Y} = \frac{Y_K K \dot{K}}{Y K} + \frac{Y_L L \dot{L}}{Y L} + \frac{Y_{Z_1} Z \dot{Z}}{Y Z} + \frac{\dot{A}}{A} + \frac{K}{Y} (Y_{K_0} - pY_{K_1}) \dot{u}_0 + \frac{L}{Y} (Y_{L_0} - pY_{L_1}) \dot{l}_0 \quad (2)$$

where a dot above variable denotes its variation from the last period ; Y_{Z_1} denotes the marginal productivity of land in agriculture ; Y_K, Y_L denote the marginal productivities of capital and labor in the economy. They can be expressed simply as a weighted average of marginal productivities in each sector:

$$Y_K = Y_{K_0} u_0 + pY_{K_1} u_1 \quad (3)$$

$$Y_L = Y_{L_0} l_0 + pY_{L_1} l_1 \quad (4)$$

Equation (2) distinguishes three main sources of growth: (a) factor accumulation, represented by the first three terms ; (b) total factor productivity (TFP) growth, represented by the term $\dot{A}/A = s_0 \dot{A}_0/A_0 + s_1 \dot{A}_1/A_1$, where A_j is the TFP level in sector j , and s_j is value added in sector j as a share of GDP ; (c) factor reallocation, represented by the two last terms.

Consider the term measuring the contribution to labor reallocation of TFP growth: \dot{l}_0 measures the rate of labor transfer from agriculture to non-agricultural sectors ; the remaining term, $L/Y(p_0 Y_{L_0} - p_1 Y_{L_1})$ measures the difference in marginal labor productivities between the two sectors $(p_0 Y_{L_0} - p_1 Y_{L_1})$ as a ratio to the average labor productivity in the economy Y/L . The term measuring the contribution of capital reallocation has a similar form.

The necessary condition for the contribution of factor reallocation to growth to be non-zero is that the spread in marginal labor productivity or marginal capital productivity across sectors be non-zero. There may be several reasons for a non-zero spread in marginal factor productivities between sectors.

First, there may be an unobserved spread in factor quality across sectors: one sector may employ relatively more skilled labor than the other or relatively better quality equipment or structures than the other.

Second, spreads may be due to production externalities: if investment in one firm has positive external effects on the accumulation of knowledge by all firms in the same sector, TFP in an individual firm will be a positive function of the average human or physical capital per worker in the sector.⁵ A spread in marginal factor productivities across sectors can —*ceteris paribus*— reflect differences in capital intensities (even at capital market equilibrium).

Third, factor markets may be non-competitive (dual): capital market institutions or imperfections (for example, a government policy of credit allocation or a moral hazard problem) can lead to a preferential interest rate for certain sectors or to selective credit rationing ; labor market institutions (for example, unions or a government policy such as a legislation on the minimum wage that would apply only to the modern sector) can lead to a modern sector wage exogenously fixed at a level higher than the competitive level.⁶

Finally, labor market segmentation can also occur under perfect competition if the modern sector pays an efficiency wage higher than the wage in the rest of the economy.⁷

B. Model assumptions

We assume that production functions in both sectors are Cobb-Douglas:

$$Y_0 = A_0 K_0^{\alpha_0'} L_0^{1-\alpha_0'} \quad (5)$$

$$Y_1 = A_1 Z^{\gamma_1} K_1^{\alpha_1'} L_1^{1-\alpha_1'-\gamma_1} \quad (6)$$

with Y_j denoting production in sector j , A_j denoting the TFP level in sector j , K_j the capital allocated to sector j , L_j the number of workers in sector j , Z the area of cultivable land, α_j' the share of capital in the value added of sector j ($j = 0, 1$) and γ_1 the share of land in the value added of sector 1.

Following Romer (1986) and Lucas (1988), we assume that TFP in sector j is a function of the capital intensity of the sector $k_j = K_j/L_j$, with an elasticity ε_j ($j = 0, 1$) and of the average level of education of the labor force h , with an elasticity β :

⁵ See Romer (1986), Lucas (1988).

⁶ Lewis (1954), Harris and Todaro (1970).

⁷ See Akerlof and Yellen (1986) for a survey of efficiency wage models of the labor market.

$$A_j = A'_j k_j^{\varepsilon_j} h^\beta \quad (7)$$

This formulation takes into account that, at the empirical level, for a large cross-section of developing countries, average levels of education are not observed at the sectoral level, but only at the aggregate level.

Given the assumptions above, and denoting y_j ($j = 0, 1$) the average product per worker in sector j and z_1 the average land per worker in sector 1, the production functions can be written in intensive form:

$$\begin{cases} y_0 = A'_0 h^\beta k_0^{\alpha_0} \\ y_1 = A'_1 h^\beta z_1^{\gamma_1} k_1^{\alpha_1} \end{cases} \quad (8)$$

Note that assumption (7) of production externalities introduces a wedge between the capital coefficient in sector j , $\alpha_j = \alpha'_j + \varepsilon_j$, and its share in the value added of the sector. In other words, the externality induces a socially inefficient allocation of resources across sectors.

The following assumptions are made concerning allocation decisions:

1. The relative price p is given on international markets (assumption of small open economy).
2. In both sectors, capital and labor are paid according to their private marginal productivities, denoted Y'_{K_j} and Y'_{L_j} respectively (for $j = 0, 1$):

$$\begin{cases} r_0 = Y'_{K_0} \\ w_0 = Y'_{L_0} \\ r_1 = pY'_{K_1} \\ w_1 = pY'_{L_1} \end{cases} \quad (9)$$

where r_j and w_j are the respective rates of remuneration of capital and labor in sector j .

C. Reallocation effects

Under the assumptions above, the contributions of factor reallocation to growth in equation (2) can be expressed as:

$$\frac{K}{Y} (Y_{K_0} - pY_{K_1}) \dot{u}_0 = \frac{\alpha_0(y_0/k_0) - \alpha_1(py_1/k_1)}{y/k} \dot{u}_0 \quad (10)$$

in the case of capital and

$$\frac{L}{Y}(Y_{L_0} - pY_{L_1}) \dot{u}_0 = \frac{(1 - \alpha_0)y_0 - (1 - \alpha_1 - \gamma_1)py_1}{y} \dot{l}_0 \quad (11)$$

in the case of labor. They thus depend on the factor reallocation rates \dot{u}_0 and \dot{l}_0 , given the intersectoral wedges in marginal factor productivities, as a ratio of the average factor productivity in the economy.

Note that at factor market equilibrium,

$$\begin{cases} w_0 = w_1 = w \\ r_0 = r_1 = r \end{cases} \quad (12)$$

expressions (10) and (11) simplify in:

$$\frac{rK}{Y} \left(\frac{\varepsilon_0}{\alpha'_0} - \frac{\varepsilon_1}{\alpha'_1} \right) \dot{u}_0 \quad (13)$$

in the case of capital and

$$\frac{wL}{Y} \left(\frac{\varepsilon_1}{1 - \gamma_1 - \alpha'_1} - \frac{\varepsilon_0}{1 - \alpha'_0} \right) \dot{l}_0 \quad (14)$$

in the case of labor. When the intersectoral spreads in marginal factor productivities are linked only to production externalities of the form (7), the contribution of factor reallocation to growth are thus simply proportional to the reallocation rates. The proportionality factor reflects the share of the factor in GDP and the other parameters of the model, including the externality parameters ε_j ($j = 0, 1$). If the factor shares in GDP and the parameters vary little between countries and periods, the reallocation effect (i.e. the impact on GDP growth of a given reallocation of capital or labor) is more or less the same in all countries at all periods.

Equation (13) implies that the condition for capital reallocation from the traditional to the modern sector to contribute to growth is:

$$\varepsilon_0 > \varepsilon_1 \frac{\alpha'_0}{\alpha'_1} \quad (15)$$

Intuitively, capital reallocation to the modern sector - for a given modern sector employment - increases capital intensity in that sector. The effect on growth will be positive as long as the modern sector benefits relatively more than the traditional sector from capital-related production externalities.

Similarly, equation (14) implies that the condition for labor reallocation to contribute to growth is:

$$\varepsilon_1 > \varepsilon_0 \frac{1 - \alpha'_0}{1 - \gamma_1 - \alpha'_1} \quad (16)$$

Intuitively, labor reallocation to the modern sector - for a given stock of capital - decreases capital intensity in that sector. The impact on growth will be negative if externalities to capital accumulation in the modern sector are stronger than in the traditional sector.

The previous results are valid only in the particular case when intersectoral wedges in marginal factor productivities result only from the presence of production externalities of the type (7). In the general case, the effect of a given factor reallocation and the conditions under which it contributes to growth vary between countries and periods. It can not be treated as a constant parameter.

Indeed, in (10) and (11), the relative productivities of capital $(y_j/k_j)/(y/k)$ and labor y_j/y in each sector ($j = 0, 1$) are endogenously determined by the allocation of resources in the economy: $(y_j/k_j)/(y/k) = \pi_j/u_j$ ($j = 0, 1$) and $y_j/y = \pi_j/l_j$ ($j = 0, 1$), where $\pi_j = Y_j/Y$ is the share of sector j in GDP. Reallocation effects thus depend on (π_0, u_0, l_0) i.e. on the productive structure of the economy at each date. This structure itself evolves endogenously over time, as a function of accumulation and allocation decisions, as we study in more detail in the next sections.

Moreover, in the general case, the condition for capital reallocation to contribute to growth can be written:

$$\frac{y_0/k_0}{y_1/k_1} > \frac{p\alpha_1}{\alpha_0} \quad (17)$$

and the condition for labor reallocation to contribute to growth can be written:

$$\frac{y_0}{y_1} \geq \frac{p(1 - \alpha_1)}{(1 - \alpha_0)}. \quad (18)$$

Both conditions are clearly endogenous since they involve the average productivity of capital in the modern sector relative to that in the traditional sector $(y_0/k_0)/(y_1/k_1)$ and the average labor productivity in the modern sector relative to the traditional sector y_0/y_1 , that are endogenously determined.

D. Resource allocation

We now specify the determinants of resource allocation at each date, taking accumulation decisions as given. Relative factor endowments (k_t, h_t, z_t) at each date t are thus considered exogenous. We also consider as exogenous the real wage in the modern sector w_{0t} and the relative price of the traditional good p_t . This last assumption corresponds to that of a small open economy. A more general model would endogenize the accumulation behaviors of physical and human capital, the determination of the wage in the modern sector, and that of the relative price. This is not, however, the aim of this paper, which focuses on taking into account the endogeneity of reallocation decisions in the empirical study of the relationship between factor reallocation and growth.

We focus on the determination of resource allocation at market equilibrium (u_{0t}^*, l_{0t}^*) , which derives at each date from producers' decisions in competitive markets. Labor demand in the modern sector yields a first relationship that must hold in equilibrium:

$$Y'_{L_{0t}} = w_{0t} \quad (19)$$

Condition (19) implies that the wage level w_0 determines the average labor productivity y_0 in the modern sector:

$$y_{0t} = \frac{w_{0t}}{1 - \alpha'_0} \quad (20)$$

and thus also, given (8), the capital intensity k_0 in that sector:

$$k_{0t} = \left[\frac{w_{0t}}{A'_{0t} h_t^\beta (1 - \alpha'_0)} \right]^{\frac{1}{\alpha_0}}. \quad (21)$$

As $k_{0t} = u_{0t} k_t / l_{0t}$, the first relationship that must be satisfied by the equilibrium solution (u_{0t}^*, l_{0t}^*) is:

$$\frac{u_{0t}}{l_{0t}} = k_t^{-1} \left[\frac{w_{0t}}{A'_{0t} h_t^\beta (1 - \alpha'_0)} \right]^{\frac{1}{\alpha_0}}. \quad (22)$$

Capital demand in the modern sector yields the second relationship that must be satisfied in equilibrium:

$$Y'_{K_{0t}} = r_{0t} \quad (23)$$

Here, however, r_{0t} is not exogenous. The assumptions made up to now do not allow to determine its equilibrium level. To find an equilibrium solution, we make the additional assumption that capital market is in equilibrium:

$$r_{0t} = r_{1t} = r_t. \quad (24)$$

This assumption seems less restrictive than that of wage equality across sectors and allows to solve the model.

Condition (24) can be rewritten:

$$\alpha'_0 A'_{0t} h_t^\beta k_{0t}^{\alpha_0 - 1} = \alpha'_1 A'_{1t} h_t^\beta z_{1t}^{\gamma_1} k_{1t}^{\alpha_1 - 1} p_t = r_t \quad (25)$$

Replacing k_{0t} in the left-hand term by its expression (21) and using the fact that $k_{1t} = (1 - u_{0t}) k_t / (1 - l_{0t})$, one obtains the second relationship that must be satisfied by (u_{0t}^*, l_{0t}^*) :

$$(1 - u_{0t})^{1-\alpha_1} (1 - l_{0t})^{\gamma_1+\alpha_1-1} = \frac{\alpha'_1 A'_1}{\alpha'_0 A'_0} \left(\frac{w_{0t}}{A'_0 h_t^\beta (1 - \alpha'_0)} \right)^{\frac{1-\alpha_0}{\alpha_0}} p_t k_t^{\alpha_1-1} z_t^{\gamma_1}. \quad (26)$$

The equilibrium allocation (u_{0t}^*, l_{0t}^*) at each date t is thus obtained as the solution of the system of equations (22) and (26), of the general form:

$$\begin{cases} u_{0t}/l_{0t} = \varphi_1(w_{0t}, k_t, h_t) \\ (1 - u_{0t})^{1-\alpha_1} (1 - l_{0t})^{\gamma_1+\alpha_1-1} = \varphi_2(w_{0t}, p_t, k_t, h_t, z_t) \end{cases} \quad (27)$$

This system has no analytical solution. The implicit solution is of the form:

$$\begin{cases} u_{0t}^* = \phi_1(w_{0t}, p_t, k_t, z_t, h_t) \\ l_{0t}^* = \phi_2(w_{0t}, p_t, k_t, z_t, h_t) \end{cases} \quad (28)$$

showing that the equilibrium allocation (u_{0t}^*, l_{0t}^*) varies between countries and periods with the real wage w_{0t} in the modern sector, the relative price p_t of the traditional good, the relative endowments in physical capital k_t , human capital h_t and land z_t .

One can finally note that once (u_{0t}^*, l_{0t}^*) determined, the other endogenous variables of the model (agricultural equilibrium wage w_{1t}^* , rate of remuneration of capital r_t^* , and rate of remuneration of land, q_t^*) are given by:

$$\begin{cases} w_{1t}^* = (1 - \gamma_1 - \alpha'_1) A'_{1t} h_t^\beta k_t^{\alpha_1} \left(\frac{1-u_{0t}^*}{1-l_{0t}^*} \right)^{\alpha_1} \\ r_t^* = \alpha'_0 A'_{0t} h_t^\beta k_t^{\alpha_0-1} \left(\frac{u_{0t}^*}{l_{0t}^*} \right)^{\alpha_0-1} = \alpha'_1 A'_{1t} h_t^\beta k_t^{\alpha_1-1} \left(\frac{1-u_{0t}^*}{1-l_{0t}^*} \right)^{\alpha_1-1} \\ q_t^* = \gamma_1 A'_{1t} h_t^\beta z_t^{\gamma_1-1} (1 - u_{0t}^*)^{\alpha_1} (1 - l_{0t}^*)^{1-\gamma_1-\alpha_1} \end{cases} \quad (29)$$

III. ECONOMETRIC SPECIFICATION AND TESTING

The previous analysis underlines the necessity of using a different empirical approach in the study of the links between reallocation and growth in a panel of countries. It shows that the standard approach (growth regressions where structural change indicators are added to the usual regressors) yields biased estimates due to the endogeneity of structural change. In this section, an alternative empirical approach to testing the effect of structural change on growth is proposed. It is closely based on the predictions of the theoretical model in the previous section and tested on a panel of 30 developing countries.

A. Econometric specification

One of the implications of the previous model is that there is a relationship at capital market equilibrium that holds between the average sectoral labor productivities y_{0t} and y_{1t} . To see this, note that capital intensity in agriculture is given, in capital market equilibrium, by:

$$k_{1t}^* = \left(\frac{\alpha'_1 A'_{1t}}{\alpha'_0 A'_{0t}} p_t z_{1t}^{*\gamma_1} k_{0t}^{*1-\alpha_0} \right)^{\frac{1}{1-\alpha_1}}, \quad (30)$$

where the symbol * denotes, as in the previous section, the equilibrium value. Inserting this in the expression (8) for the average labor productivity in agriculture, we obtain:

$$y_{1t}^* = A'_{1t} h_t^\beta z_{1t}^{*\gamma_1} \left(\frac{\alpha'_1 A'_{1t}}{\alpha'_0 A'_{0t}} z_{1t}^{*\gamma_1} p_t k_{0t}^{*1-\alpha_0} \right)^{\frac{\alpha_1}{1-\alpha_1}} \quad (31)$$

But from (8), we have

$$k_{0t}^* = \left(\frac{y_{0t}^*}{A'_{0t} h_t^\beta} \right)^{\frac{1}{\alpha_0}}. \quad (32)$$

Replacing in (31) yields the relationship that obtains at capital market equilibrium between sectoral average labor productivities:

$$y_{1t}^* = y_{0t}^{*\frac{(1-\alpha_0)\alpha_1}{\alpha_0(1-\alpha_1)}} z_{1t}^{*\frac{\gamma_1}{1-\alpha_1}} p_t^{\frac{\alpha_1}{1-\alpha_1}} h_t^{\frac{\beta\alpha_1}{1-\alpha_1} \left(\frac{1}{\alpha_1} - \frac{1}{\alpha_0} \right)} \left(A'_{1t} \right)^{\frac{1}{1-\alpha_1}} \left(A'_{0t} \right)^{-\frac{\alpha_1}{\alpha_0(1-\alpha_1)}} \left(\frac{\alpha'_1}{\alpha'_0} \right)^{\frac{\alpha_1}{1-\alpha_1}} \quad (33)$$

Equation (33) is a log-linear relationship between the variables y_{1t}^* , y_{0t}^* , z_{1t}^* , p_t , and h_t that holds for the equilibrium allocation (u_{0t}^*, l_{0t}^*) . Empirically, it thus holds at each date t only if the observed allocation (u_{0t}, l_{0t}) coincides with (u_{0t}^*, l_{0t}^*) . But it seems more realistic to suppose that allocation decisions are taken at the beginning of the period, before the relative price is observed. In that case, producers have to form an expectation of the relative price and it is the expected price, p_t^a rather than the effective price p_t , that appears in the relationship (33):

$$y_{1t}^* = y_{0t}^{*\frac{(1-\alpha_0)\alpha_1}{\alpha_0(1-\alpha_1)}} z_{1t}^{*\frac{\gamma_1}{1-\alpha_1}} p_t^a{}^{\frac{\alpha_1}{1-\alpha_1}} h_t^{\frac{\beta\alpha_1}{1-\alpha_1} \left(\frac{1}{\alpha_1} - \frac{1}{\alpha_0} \right)} \left(A'_{1t} \right)^{\frac{1}{1-\alpha_1}} \left(A'_{0t} \right)^{-\frac{\alpha_1}{\alpha_0(1-\alpha_1)}} \left(\frac{\alpha'_1}{\alpha'_0} \right)^{\frac{\alpha_1}{1-\alpha_1}} \quad (34)$$

The relationship (33) thus only holds exactly at each date t if there are no expectational errors.

To account simply for the possibility of expectational errors in the empirical formulation, we assume that price expectations are adaptive.. The expected price thus follows an adjustment mechanism of the form:

$$\ln p_t^a = \ln p_{t-1}^a + \rho(\ln p_{t-1} - \ln p_{t-1}^a), \quad (35)$$

where $(\ln p_{t-1} - \ln p_{t-1}^a)$ represents the expectational error at date $t - 1$ and ρ represents the adjustment coefficient of expectations.

Replacing (35) in the first-difference formulation of (34) yields the empirical counterpart of equation (33) under the assumption of adaptive expectations:

$$\begin{aligned} \ln \frac{y_{1,i,t}}{y_{1,i,t-1}} &= \eta_0^y \ln \frac{y_{0,i,t}}{y_{0,i,t-1}} + \eta_1^z \ln \frac{z_{1,i,t}}{z_{1,i,t-1}} + \eta^h \ln \frac{h_{i,t}}{h_{i,t-1}} + \theta_1^y \ln y_{1,i,t-1} + \theta^p \ln p_{i,t-1} \\ &+ \theta_0^y \ln y_{0,i,t-1} + \theta_1^z \ln z_{1,i,t-1} + \theta^h \ln h_{i,t-1} + \theta_i^c + u_{it}. \end{aligned} \quad (36)$$

The indices $i (= 1..N)$ and $t (= 1..T)$ index countries and time periods respectively, θ_i^c is a fixed effect to account for unobserved systematic cross-country differences in sectoral TFP growth rates (i.e. \tilde{A}_j , $j = 0, 1$), u_{it} is a white noise error term, and $\eta_0^y, \eta_1^z, \eta^h, \theta_1^y, \theta^p, \theta_0^y, \theta_1^z, \theta^h$ are parameters defined as follows:

$$\eta_0^y = \frac{(1 - \alpha_0)\alpha_1}{\alpha_0(1 - \alpha_1)}; \eta_1^z = \frac{\gamma_1}{1 - \alpha_1}; \eta^h = \frac{\beta\alpha_1}{1 - \alpha_1} \left(\frac{1}{\alpha_1} - \frac{1}{\alpha_0} \right) \quad (37)$$

$$\begin{aligned} \theta_1^y &= -\rho, \theta^p = \frac{\rho\alpha_1}{1 - \alpha_1}, \theta_0^y = \frac{\rho\alpha_1(1 - \alpha_0)}{(1 - \alpha_1)\alpha_0}, \\ \theta_1^z &= \frac{\rho\gamma_1}{1 - \alpha_1}, \theta^h = \frac{\rho\alpha_1\beta}{1 - \alpha_1} \left(\frac{1}{\alpha_1} - \frac{1}{\alpha_0} \right) \end{aligned} \quad (38)$$

Note that the sign of the coefficient θ^h depends on the physical capital intensity in the modern sector relative to that in the traditional sector: θ^h is positive when the modern sector is relatively more capital-intensive ($\alpha_0 > \alpha_1$) and negative otherwise.

From equation (36), the growth of average agricultural labor productivity between $t - 1$ and t depends on the growth of average labor productivity in non-agricultural sectors, the growth of land input per agricultural worker, the growth of human capital per worker, technical progress in each sector, and the term (in brackets) that reflects the expectational error at date $t - 1$ on the relative price of the agricultural good.

The analogy of formulation (36) with an error-correction representation of a cointegration relationship (see Engle and Granger, 1987) suggests using the estimated values of the adjustment coefficient ρ and the coefficients of the variables in levels that appear in the error-correction term to infer the values of the coefficients of the equilibrium relationship (33). Specifically, from the estimated values of the parameters defined in (38), we can infer:

$$\alpha_0 = \frac{\theta^p}{\theta^p + \theta_0^y}, \alpha_1 = \frac{\theta^p}{\theta^p - \theta_1^y}, \gamma_1 = \frac{\theta_1^z}{\theta^p - \theta_1^y}, \beta = \frac{\theta^h}{-\theta_1^z - \theta_0^y}. \quad (39)$$

A final remark is that when estimating equation (36) on a panel of countries, a number of restrictions are imposed: although the differences between countries are accounted for by allowing the intercept to vary across countries, the other coefficients are assumed to be equal across countries. Implicitly, we thus assume that the adjustment coefficient of price expectations ρ as well as the other parameters of the model $\alpha_0, \alpha_1, \gamma_1, \beta_0, \beta_1$ are the same in all countries. Note however that the assumption of identical parameters at the sectoral level in all countries is less restrictive than the usual assumption of identical parameters at the aggregate level.⁸ At the aggregate level, elasticities of GDP with respect to each production factor are given by:

$$\begin{aligned} (Y_K K/Y)_{it} &= \alpha_0 (Y_0/Y)_{it} + \alpha_1 (pY_1/Y)_{it}, \\ (Y_L L/Y)_{it} &= (1 - \alpha_0) (Y_0/Y)_{it} + (1 - \alpha_1 - \gamma_1) (pY_1/Y)_{it}, \\ (Y_{Z_1} Z/Y)_{it} &= \gamma_1 (pY_1/Y)_{it}. \end{aligned} \tag{40}$$

They vary between countries and over time with the degree of industrialization, as measured by the relative shares of each sector in GDP (Y_0/Y et pY_1/Y).

B. Estimation strategy

The main estimation difficulty of equation (36) lies in the fact that some of the variables, especially variables in levels, may be integrated of order 1. Our estimation strategy is to ignore the non-stationarity altogether and estimate equation (36) by ordinary least squares, relying on standard t and F distributions for testing hypotheses. The parameters that describe the system's dynamics are thus estimated consistently, which is crucial for our purpose of making structural inference. (see Hamilton, 1994, p. 652).

IV. DATA

Our empirical results are based on data for 30 developing countries over the 1965-80 period. Definitions of the variables, sources, and the list of countries are reported in the Appendix. Table 1 reports descriptive statistics for the sample. Over the period 1965-80, developing countries in our sample have an average growth rate of GDP per worker of about 2.5 % per year. Differences across regions are important: East Asia (EAS) and Europe-North Africa (ENA) have growth rates averaging 5 and 4 % per year respectively, while other regions have growth rates lower than 2 % per year.

Over the same period, the growth rate of physical capital per worker is on average 4 % per year, with again wide differences across regions. East Asia and Europe-North Africa

⁸ See for example the cross-country production function studies of Benhabib and Spiegel (1994), Nehru and Dharehwar (1994), and Pritchett (1996).

have growth rates of physical capital per worker of about 8 and 5 % per year respectively. In Sub-Saharan Africa (SSA) and in Latin America (LAT), the growth rate of physical capital per worker is lower than 4 % per year, while in South Asia (SAS), it is lower than 3 % per year.

The average rate of decrease of area of cultivable land per worker for the sample is about 2 % per year. The decrease reflects the fact that the increase in cultivable areas has not kept up with the growth of the labor force. The decrease in relative endowments of cultivable land is especially strong in Sub-Saharan Africa (SSA).

The modern sector represents on average for the sample less than three quarters of GDP and less than half of the labor force. But there are marked differences between regions. In Sub-Saharan Africa and South Asia, which are the two least industrialized regions, the modern sector represents less than two-thirds of GDP and less than a third of the labor force (less than a quarter in Sub-Saharan Africa). In Latin America, which is the most industrialized region, it represents more than 80 % of GDP and more than 60 % of the labor force.

Average labor productivity in the modern sector represents on average for the sample more than one and a half times that in the whole economy and more than three times that in agriculture.⁹ The intersectoral spread in average labor productivities is especially important in Sub-Saharan Africa and South Asia, where the average productivity of labor in the modern sector represents more than four times that in agriculture.

The rate of labor reallocation, measured by the annual variation of the share of labor employed in the modern sector, is on average in the sample about two thirds of a percentage point per year. Here again, there are wide differences between regions. In Sub-Saharan Africa, the rate of labor reallocation is only on average half a percentage point per year. In South Asia, it is only half that of the average developing country (about a third of a percentage point per year). In other regions, it is higher than three quarters of a percentage point per year.

Differences in the rate of labor reallocation can be explained to a certain extent by differences in physical and human capital accumulation, as the following regression suggests (\bar{x}_i represents the average of x for the country i):

$$\begin{aligned} \bar{l}_{0i} &= 0.046 \bar{k}_i + 0.055 \bar{h}_i - 0.004 SSA - 0.004 SAS + 0.005 & (41) \\ &\quad (2.46) \quad (1.90) \quad (-2.69) \quad (-2.16) \quad (3.76) \\ (\bar{R}^2 &= 0.40, 30 \text{ observations}) \end{aligned}$$

⁹ This is the order of magnitude reported in Dowrick and Gemmel (1991) for their sample of 78 countries (including 56 developing countries) over the period 1973-85: in the average country of their sample, the average labor productivity in the modern sector is 3.4 times that in agriculture.

Regression (41) shows that the rate of labor reallocation tends to increase with the rate of physical and human capital accumulation (although for the latter, the coefficient is only statistically different from zero at the 10 % level of significance). Dessus (1997) finds a similar positive association between growth of the education level and rate of labor reallocation in the case of the Taiwanese economy over the postwar period. The interpretation he suggests is that education fosters intersectoral mobility of labor. The negative coefficients of the region dummies *SSA* and *SAS* in (41) show however that differences in physical and human capital accumulation alone cannot explain the relatively weak rates of labor reallocation across sectors in Sub-Saharan Africa and South Asia.

V. ESTIMATION RESULTS

Estimations use the 15 annual observations available for each country. We also report growth accounting results using period averages.

A. Model estimation

We report in Table 2 the estimation results of equation (36). All the variables of the term representing the equilibrium error of the previous date have expected signs: negative for $\ln(y_{1i,t-1})$ and positive for $\ln(p_{i,t-1})$, $\ln(y_{0i,t-1})$, and $\ln(z_{1i,t-1})$. Note also that the positive sign of θ_h indicates a physical capital coefficient higher in the modern sector than in agriculture ($\alpha_0 > \alpha_1$).

B. Sectoral production functions

Given the relationships (39) between the estimated coefficients of equation (36) and the parameters of the theoretical model, the previous results imply sectoral production functions of the form:

$$\begin{cases} Y_0 = A'_0 h^{0.66} K_0^{0.38} L_0^{0.62} \\ Y_1 = A'_1 h^{0.66} K_1^{0.13} Z^{0.80} L_1^{0.07} \end{cases} \quad (42)$$

The role of education appears important, with an estimated elasticity of production with respect to the average education level of 0.66. In the modern sector, the elasticity of production with respect to education is comparable to that with respect to labor, 0.62.

The modern sector appears more intensive in physical capital than the traditional sector, a result consistent with the positive sign of θ_h in Table 2. The coefficient of physical capital in the modern sector production function, 0.38, is about three times higher than in the agricultural production function, 0.13. Based on the average production structure in our sample (the modern sector share is about 73 % of GDP in Table 1) and on the estimated

sectoral coefficients, formula (40) yields an average elasticity of GDP with respect to physical capital of about 0.31.

The agricultural sector appears land-intensive, with a coefficient of land in the agricultural production function of 0.80. Given the strong land intensity of the agricultural sector, the modern sector appears not only more physical capital intensive than agriculture, but also more labor-intensive: the coefficient of labor in the modern sector production function is 0.62, while it is 0.07 in the agricultural production function (i.e. almost nine times higher).

The results obtained are consistent (positive sign of θ_h consistent with the result $\alpha_0 > \alpha_1$) and appear qualitatively plausible, since they indicate a modern sector more intensive in physical capital and labor and an agricultural sector more intensive in land. Moreover, quantitatively, the values found for the modern sector production function appear plausible.

However, for the agricultural production function, the values found differ markedly from those reported by the most recent study by Mundlak, Larson, and Butzler (1997). This study estimates the agricultural production function for a sample of 37 countries (including 25 developing countries), using estimates of the agricultural capital stocks based on agricultural investment series and taking also into account the role of fertilizers (the role of education however is not taken into account). It also uses a fixed effects regression and assumes constant returns to scale. The labor coefficient obtained, 0.47, is almost twice less than that found in this paper, and the physical capital coefficient, 0.37, is almost three times higher. These differences may partly reflect the fact that we focus on a sample including only developing countries, while the Mundlak, Larson, and Butzler sample includes 12 industrialized countries. Land has relatively less importance in modern agriculture compared to traditional agriculture, while physical capital has relatively more importance. This may partly explain the difference between their results and ours.

The relatively low value of the labor coefficient in the agricultural production function reported in this study as well as in Mundlak, Larson, and Butzler (1997) raises questions. It implies that the labor coefficient in the modern sector production function is 8.9 times higher than in the agricultural production function. Consequently, the marginal productivity of labor is 29.4 times higher in the modern sector than in agriculture (based on a value of 3.3 for the ratio of average sectoral labor productivities in Table 1). A ratio of 1 to 29 for the sectoral marginal productivities of labor seems high in view of the observed sectoral differences in wages in developing countries. The result could reflect an under-estimation of the elasticity of agricultural production with respect to labor. This study, like Mundlak, Larson, and Butzler (1997), uses the labor force in agriculture as a proxy for L_{1it} . If agricultural laborers allocate their time between agricultural work and other activities (services, etc.) which are not accounted for in the value added of the agricultural sector Y_{1it} , the labor force in agriculture overestimates effective labor input in that sector. The effect is an under-estimation of the

labor coefficient in the agricultural production function.¹⁰ The estimations of the intersectoral spread in marginal labor productivities obtained in this study should thus be considered as upper limits.

C. Reallocation effects

Capital

Given our assumption of capital market equilibrium, the contribution of capital reallocation to GDP growth in equation (2) is reduced to:

$$\frac{rK}{Y} \left(\frac{\varepsilon_0}{\alpha'_0} - \frac{\varepsilon_1}{\alpha'_1} \right) \dot{u}_{0it} . \quad (43)$$

It is thus positive and non-zero only if there are sufficiently strong externalities to capital accumulation in the modern sector. Assuming a constant share of capital in GDP, the contribution of capital reallocation to growth is thus proportional to the rate of capital reallocation, \dot{u}_{0it} . The proportionality factor is a function of the parameters of the model, in particular the externality parameters ε_0 and ε_1 .

The results obtained do not allow us to compute the effect of capital reallocation on growth because they do not allow to identify the coefficients ε_0 and ε_1 . Moreover, \dot{u}_{0it} is not observed. It is only known, from (28), that it varies with the level of the real wage in the modern sector, the relative price, the relative land, physical capital, and human capital endowments.

By making a few simple assumptions, one can evaluate nevertheless the order of magnitude of the capital reallocation effect on growth. If $r_{it}K_{it}/Y_{it} \simeq 0.31$ as implied by our estimates and if we assume $\varepsilon_1 = 0$ (no externalities in agriculture) and $\alpha'_0 = 1/3$ (a share of physical capital in the modern sector equal to about one third of value added), the implied value for ε_0 is 0.05. Under these assumptions, a reallocation of 1 % of the total capital ($\dot{u}_{0it} = 0.01$) increases by about 0.05 % the annual rate of growth of GDP: the effect of capital reallocation on GDP growth in our sample is virtually zero.

This result contrasts with those of Robinson (1971), obtained for a sample of 39 developing countries over the period 1958-66, and of Feder (1986), obtained for a sample of 30 semi-industrialized countries over the period 1965-73. Robinson's estimates (resp. Feder's) imply that a reallocation of 1 % of the total capital increases by 1.07 (resp. 0.86) % on average the annual growth rate of GDP.

¹⁰ We thank David Dollar for suggesting this explanation.

It is consistent nevertheless with the results of individual case studies: Dessus (1997), for example, finds in a growth accounting study of Taiwan, that capital reallocation across sectors has had virtually no impact on TFP growth (and thus on GDP growth) in Taiwan over the period 1961-90 (the estimated TFP gains from a reallocation of 1 % of the total capital were 0.03 % per year).¹¹

Labor

The expression of the contribution of labor reallocation to GDP growth per worker is, from (11):

$$\frac{(1 - \alpha_0)y_0 - (1 - \alpha_1 - \gamma_1)py_1}{y} l_0 \quad (44)$$

Replacing the parameters in expression (44) by their estimated values yields the expression of the labor reallocation effect for each country at each date:

$$d_{i,t-1}(l_{0,i,t} - l_{0,i,t-1}), \quad (45)$$

where

$$d_{i,t-1} = \frac{0.62y_{0,i,t-1} - 0.07y_{1i,t-1}}{y_{i,t-1}} \quad (46)$$

$$(47)$$

measures the intersectoral spread in marginal labor productivity, as a ratio of GDP per worker degree of dualism (at constant 1987 prices, i.e. $p = 1$).

Table 4 summarizes the cross-section results for the estimated spreads in marginal labor productivities across sectors. It shows first of all that the spread represents on average more than one time GDP per worker. This result implies, from equation (2), that a reallocation of 1 % of the labor force increases on average GDP per worker growth by 1.2 % per year: labor reallocation effects appear important, compared to physical capital reallocation effects. The estimated effect is however almost twice smaller than suggested by the results of Robinson (1971), obtained by cross-section regression for a sample of 39 developing countries over the period 1958-66. Here again, the difference could be partly explained by an endogeneity bias affecting Robinson's estimates and leading to an overestimation of the labor reallocation effect.

¹¹ The author considered a decomposition of the Taiwanese economy in nine sectors, including agriculture.

Moreover, Robinson's study treats the spread in marginal labor productivities across sectors (as a ratio to GDP per worker) as an identical parameter for all countries. The results in Table 4 raise questions on this approach, since they show an important variation across countries. It is in Sub-Saharan Africa that the intersectoral spread in marginal labor productivity is most important: it represents almost twice GDP per worker. It is weaker in Europe-North Africa and Latin America, where it represents less than 90 % of GDP per worker.

Confirming the result by Dowrick and Gemmel (1991), we find that differences in the intersectoral spread in marginal labor productivities across sectors can be explained to a certain extent by differences in development levels. Specifically, denoting \bar{x}_i the average of variable x for country i , we have:

$$\bar{d}_i = -0.249 \ln \bar{y}_i + 0.589 SSA + 2.908 \quad (48)$$

(-2.50)
(2.89)
(3.69)

(between estimations, 30 observations, $\bar{R}^2 = 0.50$)

Regression (48) shows that the spread in marginal labor productivity across sectors (d_{it}) tends to decrease with the level of economic development ($\ln y_{it}$). The positive coefficient of SSA shows however that the development level alone cannot explain the relatively high value of d_{it} in Sub-Saharan Africa.

The contribution of labor reallocation to per worker GDP growth, as shown in formula (45), depends not only on $d_{i,t-1}$, but also on $(l_{0,i,t} - l_{0,i,t-1})$, i.e. on the rate of labor reallocation from agriculture to non-agricultural sectors. As suggested by regressions (48) and (41), this contribution tends to decrease with the development level through $d_{i,t-1}$ and to increase with the rates of accumulation of physical and human capital through $(l_{0,i,t} - l_{0,i,t-1})$. The two effects can cancel each other, as in Sub-Saharan Africa for example, where a relatively weak labor reallocation rate coexists with an important wedge in marginal labor productivities between sectors. Table 5 summarizes the results in the form of a decomposition of the sources of growth of GDP per worker.

The contribution of factor accumulation to GDP per worker growth is positive in all regions in the case of physical capital, negative in the case of land. The land input measured by the area of cultivable land per worker has decreased on average over the period in all developing regions, because the area of cultivable land has increased less rapidly than the labor force.

The contribution of productivity growth to the growth of per worker GDP is decomposed in the effect of the increase in average education (positive in all regions), the effect of labor reallocation (positive in all regions), and a residual effect (negative in all regions). To give a structural interpretation to the unexplained negative residual, it would be

necessary to go beyond the traditional neoclassical growth model¹² where the unexplained residual is attributed only to the effect of technical progress. This methodology leads to interpret a negative unexplained residual as “technical regression.” A more plausible interpretation could be given to the negative residual if the definition of productivity is extended to account not only for factors hidden in the technical progress term, but also for political and economic factors (institutions and government policies) that introduce distortions affecting private agents’ decisions.

The average contribution of labor reallocation is 0.75 % per year, i.e. almost a third of the annual growth of GDP per worker. As a comparison, the results of Feder (1986) imply a contribution of factor reallocation (labor and capital) of more than 2.19 % per year, i.e. more than 50 % of GDP per worker growth (which averages 4.34 % per year in his sample). Here again, the comparison suggests that the cross-section regression approach of Feder and similar studies leads to overestimate the contribution of reallocation to growth. The approach proposed in this study yields an evaluation of the mean contribution of factor reallocation to growth consistent with the results of individual case studies: Dessus (1997), for example, finds that the contribution of labor reallocation to growth in Taiwan is 0.70 % per year, of the same order of magnitude as in this study.

East Asia is the region where the contribution of labor reallocation to growth is highest (almost 1 % per year). In Sub-Saharan Africa, the contribution of labor reallocation is also important (0.93 % per year), the important wedge in marginal labor productivity between sectors compensating the relatively weak rate of labor reallocation. South Asia is the region where the contribution of labor reallocation to growth is lowest, reflecting a low rate of labor reallocation.

VI. CONCLUSION

This paper presented a theoretical two-sector model where the rates of factor reallocation and the intersectoral wedge in marginal factor productivity, determining the effect of factor reallocation on growth, are both endogenous: they depend on changes in the relative price, in the modern sector real wage, and in relative endowments of production factors (physical capital, human capital, and cultivable land).

Our empirical work uses an approach based on the theoretical relationship that holds between average sectoral labor productivities, the expected relative price, and factor endowments at equilibrium of the capital market. The estimation of a dynamic formulation of this relationship on a panel of 30 developing countries over the period 1965-80 allows to infer values for the parameters of the underlying structural model. These determine factor intensity in each sector and the intersectoral spread in marginal factor productivities. The main results can be summarized as follows:

¹² Solow (1956).

- the modern sector is more physical capital-intensive than agriculture, and also more labor-intensive given the high land-intensity of agricultural production ; the role of human capital is important in both sectors ;
- given the sectoral production differences, the wedge in marginal labor productivity between sectors is very important, representing on average about 120 % of GDP per worker ; it varies between countries, from 80 % of GDP per worker on average in Latin American countries to 180 % in Sub-Saharan Africa ; the development level alone explains about half of these cross-country differences, although it is insufficient to explain the high value of the intersectoral spread in marginal labor productivities in Sub-Saharan Africa countries ;
- the contribution of factor reallocation to growth essentially reflects the effect of labor reallocation since the intersectoral spread in marginal physical capital productivities appears negligible; the labor reallocation effect is important since its annual contribution to growth of per worker GDP is 0.75 % per year, i.e. about a third of the annual growth of per worker GDP ; its estimated contribution to growth varies across countries ; it is the highest in East Asia (0.95 % per year), but represents only a fifth of the annual growth of GDP per worker in this region ; it is also high in Sub-Saharan Africa (0.93 % per year), where it represents more than half the annual growth of GDP per worker ; finally, it is lowest in South Asia (0.44 % per year), essentially due to the weak labor reallocation rate in this region.

Our results differ markedly from those of Robinson (1971) and Feder (1986) using the cross-section growth regression approach. Although still significant, the effect of labor reallocation on growth is quantitatively less important in this study (almost twice less important than suggested by Robinson's results) and the estimated effect of physical capital reallocation is virtually zero. Moreover, our results confirm Dowrick and Gemmel (1991)'s critic of the assumption that the labor reallocation effect can be treated as a constant parameter, identical for all countries. For both reasons, the cross-section growth regression approach does not yield a correct evaluation of the effects of factor reallocation: it tends to overestimate them and does not allow for their differences across countries and periods.

In terms of economic policy, the results in this paper highlight the importance of labor market rigidities in the growth process. Labor market flexibility —flexibility of the real wage in the modern sector— can foster growth through its positive effect on the efficiency of labor allocation. The results also point to the importance of incentives to accumulate physical and human capital. Capital accumulation not only has a direct positive impact on growth, it also has an indirect effect, by fostering an increase in labor demand of the modern sector and thus in the share of labor employed in that sector.

Table 1. Region Averages, 1965-80, 30 Developing Countries

	Average	SSA	EAS	SAS	ENA	LAM
$\ln(y_{it} / y_{i,t-1})$	2.40	1.81	4.67	1.57	3.73	1.99
$\ln(k_{it} / k_{i,t-1})$	4.05	3.52	8.27	2.59	5.23	3.31
$\ln(z_{it} / z_{i,t-1})$	-1.94	-2.30	-1.31	-1.69	-1.77	-1.97
$s_{0,i,t-1}$	73	60	74	60	77	84
$l_{0,i,t-1}$	45	24	41	31	53	62
$(y_0 / y)_{i,t-1}$	162	250	180	194	145	136
$(y_1 / y)_{i,t-1}$	49	53	44	58	49	42
$(y_0 / y_1)_{i,t-1}$	331	472	409	335	296	324
$i_{0,i,t}$	0.68	0.53	0.80	0.33	0.93	0.75
$\ln(h_{it} / h_{i,t-1})$	3.55	6.46	2.33	2.24	4.06	2.08
Obs.	30*15=450	120	45	45	60	180

Note: in percentage points

Table 2. Regression for Agricultural Labor Productivity Growth

Variable	Coefficient	Estimated Value (Student t)
$\ln(y_{0,i,t} / y_{0,i,t-1})$	η_0^y	0.206 (3.06)
$\ln(z_{1,i,t} / z_{1,i,t-1})$	η_1^z	0.350 (1.63)
$\ln(h_{it} / h_{i,t-1})$	η^h	1.662 (3.98)
$\ln(y_{1,i,t-1})$	θ_1^y	-0.354 (-7.72)
$\ln(p_{i,t-1})$	θ^p	0.051 (2.16)
$\ln(y_{0,i,t-1})$	θ_0^y	0.084 (2.67)
$\ln(z_{1,i,t-1})$	θ_1^z	0.325 (5.50)
$\ln(h_{i,t-1})$	θ^h	0.178 (5.17)
Observations		15*30=450
\bar{R}^2		0.18

Notes: 1965-80, 30 developing countries ; dependent variable: $\ln(y_{1,i,t} / y_{1,i,t-1})$; OLS estimation with fixed effects and White variance-covariance matrix corrected for heteroskedasticity.

Table 3. Estimated Intersectoral Spread in Marginal Labor Productivity

	Average	SSA	EAS	SAS	ENA	LAM
$d_{i,t-1}$	1.19	1.83	1.29	1.24	0.87	0.84
Obs.	450	120	45	45	60	180

Note: 1965-80, 30 developing countries.

Table 4. Sources of Per Worker GDP Growth

	Mean	SSA	EAS	SAS	ENA	LAM
GDP per worker growth	2.40	1.81	4.67	1.57	3.73	1.99
Explained by:						
Physical capital per worker	1.27	0.99	2.58	0.75	1.69	1.11
Cultivable land per worker	-0.42	-0.74	-0.30	-0.54	-0.33	-0.23
Education	2.35	4.26	1.54	1.48	2.68	1.37
Labor reallocation	0.75	0.93	0.95	0.44	0.82	0.64
Unexplained residual	-1.55	-3.63	-0.10	-0.56	-1.13	-0.90
Obs. (countries* years)	30*15	8*15	3*15	3*15	4*15	12*15

Note: 1965-80, 30 developing countries ; in percentage points.

A. Variables, Definitions, Data Sources

Variable	Definition
L	Labor force
Y	GDP at market prices
K	Physical capital, constant 1987 US \$
h	Average years of schooling in population aged 15-64
Z	Cultivable land area, hectares
l_1	Labor force in agriculture, as a share of total labor force
p_1	Deflator of value added in agriculture, index=100 in 1987
p_0	Deflator of value added in industry and services, index=100 in 1987
Y_1	Value added in agriculture, constant 1987 US \$
Y_0	Value added in industry and services, constant 1987 US \$

The data used to construct all variables (except K and h) are from World Bank (1995). The data for K and h , are from Nehru and Dharehwar (1993) and Nehru, Swanson, and Dubey (1995) respectively.

B. Country List

Countries included were selected from an original sample of 37 countries for which all the data needed to construct the variables were continuously available, on an annual basis, from the two above-mentioned sources. The selection criterium was to exclude countries for which in a regression of $\ln(Y_1/Y_0)_t$ on $\ln(Y_1/Y_0)_{t-1}$, $\ln(p_1/p_0)_{t-1}$, fixed effects and country-specific time trends, the relative price variable was significantly negative : such a finding raises doubt on the applicability of our model to these countries and/or on the data. The 7 countries thus excluded were: Sudan, Pakistan, Turkey, Argentina, Ecuador, Honduras. The 30 remaining countries are listed below in 5 regional groups:

Sub-Saharan Africa: Cote d'Ivoire, Cameroon, Ghana, Kenya, Nigeria, Senegal, Sierra Leone, Tanzania

East Asia: South Korea, Philippines, Thailand

South Asia: Bangladesh, India, Sri Lanka

Europe-North Africa: Egypt, Morocco, Tunisia, Greece

Latin America: Bolivia, Brazil, Chile, Colombia, Costa Rica, Jamaica, Mexico, Panama, Paraguay, El Salvador, Uruguay, Venezuela.

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