204
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Wage Differential, the Price of Services and Welfare

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Abstract

A three-goods general equilibrium model is developed to examine the effect of economic growth on the price of services and welfare for poor and rich countries. The presence of intersectoral wage differentials provides an alternative explanation for the lower price of services in poor countries. The price of services is shown to play a central role in determining the welfare effect of economic growth.

I. Introduction

In an important study of world products and income, Kravis, Heston and Summer [1982] observed a positive relationship between service prices and real per capita GDP. Why are services and other nontraded goods cheaper in poor countries? Several theoretical explanations have been put forward to answer this question first raised by Harrod [1939]. Balassa [1964] and Samuelson [1964] offer an explanation based upon differential relative labor productivity between rich and poor countries. Kravis and Lipsey [1983] and Bhagwati [1984] present an alternative explanation in terms of differential factor endowments. Panagariya [1988] puts

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forward economies of scale as an explanation. More recently, Feldman and Gang [1987, 1990] illustrate linkages between financial repression and relatively low service prices.

The present paper attempts to provide another explanation for the existence of lower service prices in poor countries. As commonly observed, poor and less-developed countries are generally characterized by substantial factor market distortions such as intersectoral wage differentials.[1] Although rich and developed countries may also exhibit factor market distortions, the degree of distortions in the rich countries is far less than that existing in the poor countries. The main purpose of this paper is to show how the substantial intersectoral wage differentials present in poor countries can give rise to lower service prices. The secondary purpose of the paper is to examine the differential welfare effects of economic growth for poor and rich countries. Our result reveals that economic growth is always welfare-improving for rich countries, whereas growth may be immiserizing for poor countries.

For the purpose of analysis, a three-goods general equilibrium model is developed with and without intersectoral wage differentials. The model is utilized to explore the impact of technical progress on the price of services and the welfare of poor and rich countries. The remainder of the paper is organized as follows: Section II outlines the production structure of the three-goods general equilibrium model; Section III explores the price as well as the welfare effects of technical progress for rich and poor countries; and Section IV provides concluding remarks.

II. The Production Structure

We consider a small, open economy, engaging in three types of production activities: urban manufactures, X; urban services, Z; and rural agriculture, Y. The poor (rich) countries export (import) agricultural products and import (export) manufacturing goods at exogenously given world prices. Services are, however, non-traded, so their price is determined domestically.

Labor and capital are used by all sectors; while labor can move among sectors, capital is sector-specific. Each sector utilizes constant returns to scale technology; factors exhibit positive but diminishing marginal products and positive cross partials.

1. There exists a large body of literature on the implications of intersectoral wage differentials. See, for example, Batra [1973, Ch. 10], Hazari [1978], among others.

Production functions for the urban manufactures, urban services and rural agriculture are:

$$X = X(L_X, K_X, \alpha), \tag{1}$$

$$Z = Z(L_Z, K_Z), \tag{2}$$

$$Y = Y(L_Y, K_Y), \tag{3}$$

where L_i and K_i denote employment of labor and capital of the ith sector $i = X$, Z, Y), respectively. Note that α represents the growth agent for manufactures; $\alpha = 1$ initially. For simplicity, we will only analyze the effects of growth of manufactures; the effects of technical progress in other sectors can be analogously studied.

To capture the distinguishing features of the *poor country*, we make the following assumptions. Although workers are allowed to move freely among urban manufactures, urban services and rural agriculture, urban manufacturing wages (w_x), however, are inflexible. They are fixed at levels higher than the market-clearing wages. Hence, a fraction of the workers in the urban sector cannot find employment in manufactures. These workers, however, will be absorbed by the urban service (or informal) sector paid at wages w_z, if they stay in the urban area. Unlike manufacturing wages, service and agricultural wages are determined by market forces. Thus, full employment entails in this modified Harris-Todaro economy.[2] Labor market equilibrium occurs when labor migration from the rural to the urban sector ceases. Equilibrium requires that the agricultural wage be equal to the expected urban wage, which is a weighted average of the manufacturing and service sector wages. Let $L_X / (L_X + L_Z)$ and $L_Z / (L_X + L_Z)$ be respectively the probability of finding employment in manufactures and services. The equilibrium condition may be described as[3]

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2. The Harris-Todaro [1970] model is a two-sector general equilibrium framework with intersectoral wage differential. A distinguishing feature of the model involves urban unemployment due to urban wage rigidity. For expositions of the various facets of the Harris-Todaro model, see Corden and Findlay [1975], Neary [1981], Khan [1982], and more recently, Batra and Naqvi [1987], Beladi [1988], Beladi and Naqvi [1988], and Chao and Yu [1990], among others.
3. For an excellent discussion on the modified labor migration equilibrium condition, see Feldman and Gang [1990]. Equation (14) is adapted from their formulation.

$$w_Y = w_X[L_X / (L_X + L_Z)] + w_Z[L_Z(L_X + L_Z)]. \tag{4}$$

Letting $\lambda = L_Z / L_X$ be the service/manufacturing employment ratio, (4) can be rewritten as

$$(1+\lambda)w_Y = w_X + \lambda w_Z. \tag{5}$$

Note that this condition is meaningful only if

$$w_Z \leq w_Y \leq w_X. \tag{6}$$

This intersectoral wage ranking turns out to be consistent with the stability condition (see Appendix for derivations). Thus, it is assumed that the condition (6) holds throughout the subsequent analysis for the poor country.

Regarding the *rich country*, we assume that its economy is characterized by the absence of factor market distortions. So wages in all three sectors are determined by labor market forces. Free mobility of labor among the three sectors results in wage equalization:

$$w_X = w_Z = w_Y, \tag{7}$$

which is a special case of (6).

Under perfect competition, labor is paid according to the value of its marginal product:

$$w_X = pX_L, \tag{8}$$

$$w_Z = qZ_L, \tag{9}$$

$$w_Y = Y_L, \tag{10}$$

where p and q are the relative price ratio of good X and Z in terms of good Y, respectively.

Denoting the total endowment of labor by $\overline{L}$, the full employment condition requires that labor demand equals its supply:

$$L_X + L_Z + L_Y = \overline{L},$$

which can be written as

$$(1+\lambda)L_X + L_Y = \overline{L}. \tag{11}$$

With regard to capital, it is assumed to be sector specific; that is

$$K_i = \overline{K}_i,\ i = X,\ \mathrm{Y},\ \mathrm{Z}, \tag{12}$$

where $\overline{K}$ denotes the capital endowment.

Eqs (1) – (6) and (8) – (12) describe the production side of the poor country, while (1) – (3) and (7) – (12) depict that of the rich country. A comparison of the two sets of the equations readily indicates that the only difference between the poor and the rich country is the presence of intersectoral wage differentials in the former and the absence of wage differentials in the latter.

Facing the given relative goods prices, p, q, and the state of technology, α, firms in sector i determine the optimal level of employment of labor, L_i, for their production. Thus, we may write $L_i = L_i(p,\ q,\ \alpha)$, $i = X$, Z and Y. In view of this formulation and the sector-specific capital, the production functions in (1) – (3) can be rewritten as

$$X = X(L_X,\ K_X,\ \alpha) = \tilde{X}(p,\ q,\ \alpha), \tag{13}$$

$$Z = Z(L_Z,\ K_Z) = \tilde{Z}(p,\ q,\ \alpha), \tag{14}$$

$$Y = Y(L_Y,\ K_Y) = \tilde{Y}(p,\ q,\ \alpha). \tag{15}$$

Thus, sectoral outputs are dependent upon the relative goods prices and the state of technology in the manufacturing sector.

At this juncture, it is useful to derive the equilibrium condition concerning transformation between the outputs and the relative goods prices. It turns out that the service/manufacturing employment ratio, $\lambda = L_Z / L_X$, plays the crucial role in determining the equilibrium condition of production. Differentiating (1) – (3) and (11), and some manipulation yield

$$pdX + qdZ + dY = pX_\alpha d\alpha - L_X(w_Y - w_Z)d\lambda \tag{16}$$

which is not equal to zero at a given state of technology ($d\alpha = 0$) for the poor

country. Apparently, a distortion is created by the wage differential, $(w_Y - w_Z)$. Eq (16) implies that the goods – price plane cuts the shrunk-in production transformation frontier. This is a well-known result in the distortion literature and needs no elaboration here.

For the rich country, we have the special case of wage equalization, $w_Y = w_Z$. Then $pdX + qdZ + dY = 0$ at a given level of α. Thus, we have confirmed the traditional result regarding the tangency between the goods – price plane and the production transformation frontier at production equilibrium.

To further ascertain the relationship between the production transformation frontier in the case of the poor country, we need to determine the magnitude of $d\lambda$ by conducting comparative statics exercises. As shown in the appendix, by using the equations of immediate relevance, i.e., (4) – (12), we can solve, in particular, for L_X, L_Y, λ and w_Z as functions of p, q and α. For simplicity, we will suppress p since the world prices for traded goods are given. The results can be intuitively explained as follows:

An increase in the price of services tends to raise the wages in the service sector. The higher service wages will induce rural workers to migrate to urban areas. The new migrants cannot find jobs in manufactures because the increase in the service price does not affect the value of the marginal product of labor in manufactures. Consequently, migrant workers find employment in the service sector (i.e., $\partial\lambda / \partial q > 0$). Thus, the increase in the service price results in greater output at the expense of the agricultural output, while leaving the manufacturing output unaffected. That is, $\partial \tilde{Z} / \partial q > 0$, $\partial \tilde{Y} / \partial q < 0$ and $\partial \tilde{X} / \partial q = 0$.

Turning to the effects of technical progress in manufacturing at constant relative goods prices. We note from (8) that $\partial L_X / \partial \alpha > 0$ since a rise in L_X needs to offset the increased labor productivity in manufactures caused by technical progress. Hence, the growth-induced increase in the demand for labor in manufactures will result in the hiring of more workers to be drawn from the service and agricultural sectors. This reduces employment in the agricultural sector ($\partial L_Y / \partial \alpha < 0$); however, the result on service employment is ambiguous for the poor country. This is simply due to the fact that labor migrates from the rural to the urban areas, and concurrently moves from urban services to urban manufactures. Since only a fraction of the new migrants are able to find jobs in manufactures, the remaining workers in the urban areas are absorbed by the service sector. The influx of workers into the urban areas, plus the loss of service workers to manufactures, renders the

effect of technical progress on service employment far from categorical ($\partial L_Z / \partial\alpha \gtrless 0$). However, technical progress in manufacturing reduces the service/manufacturing employment ratio ($\partial\lambda / \partial\alpha < 0$) even in the case of $\partial L_Z / \partial\alpha > 0$.[4]

Consider the effects of technical progress for the rich country in which wages in all three sectors are equal. Due to the assumptions of free mobility and full employment of labor, technical progress in manufacturing will draw workers from the service and the agricultural sector. This implies that $\partial L_Z / \partial\alpha < 0$ and $\partial \tilde{Z} / \partial\alpha < 0$. Thus, technical progress in manufactures of the rich country, unlike the earlier case of the poor country, results in a reduction in service employment and the output of the service sector. The differential impact due to wage differentials will play a central role in the welfare analysis in Section III below.

It is enlightening to rewrite (16) as

$$pdX + qdZ + dY = pX_\alpha d\alpha - L_X(w_Y - w_Z)[(\partial\lambda / \partial q)dq + (\partial\lambda / \partial\alpha)d\alpha], \quad (17)$$

which contains various price and welfare implications of economic growth.

The production side of the model can be summarized by the economy's revenue function:

$$R(p,\ q,\ L_X,\ L_Z,\ L_Y,\ \alpha) = pX(L_X, K_X, \alpha) + qZ(L_Z,\ K_Z) + Y(L_Y,\ K_Y). \quad (18)$$

From the well-known duality theory, we have the following properties: $\partial R / \partial q = R_q = Z$, $R_{LX} = w_X$, $R_{LZ} = w_Z$, $R_{LY} = w_Y$ and $R_\alpha = pX_\alpha$. Note that $L_i (i = X,\ Z,\ Y)$ enter as arguments in the revenue function because a reallocation of labor among sectors will affect the nation's revenue due to the existence of wage differentials in the poor country. In contrast, L_i may not be included in the revenue function for the rich country.

III. Effects of Economic Growth

To analyze and compare the effects of economic growth on the price of services

4. Suppose increases in employment for manufacturing are completely drawn from the agricultural sector. Then changes in the service/manufacturing employment ratio are $(\partial\lambda / \partial\alpha) = (\partial L_Z / \partial\alpha - \lambda\partial L_X / \partial\alpha) = 0$ since $\partial L_Z / \partial\alpha = -[\lambda / (1+\lambda)](\partial L_Y / \partial\alpha)$ and $\partial L_X / \partial\alpha = -[1 / (1+\lambda)](\partial L_Y / \partial\alpha)$. However, some new workers are actually hired from the service sector. This reduces the labor supply in the services and hence $\partial\lambda / \partial\alpha < 0$.

and the welfare of the poor versus the rich country, we need to turn to the demand side of the economy. The demand side is represented by an expenditure function defined by

$$E(p,\ q,\ u) = \min\ (pC_X + qC_Z + C_Y), \tag{19}$$

with respect to consumption of goods X, Z and Y, subject to a strictly quasi-concave utility function $u(C_X,\ C_Z,\ C_Y) \geq u$.

We complete the task of specifying the model by introducing the economy's budget constraint and the market clearing condition for services as follows:

$$E(p,\ q,\ u) = R\ (p,\ q,\ L_X,\ L_Z,\ L_Y,\ \alpha) \tag{20}$$

$$E_q(p,\ q,\ u) = R_q(p,\ q,\ L_X,\ L_Z,\ L_Y,\ \alpha) = \tilde{Z}(p,\ q,\ \alpha), \tag{21}$$

where $E_q = \partial E / \partial q$ denotes the compensated demand for services and R_q, as noted earlier, is the supply of services. Eq (20) states that the consumption expenditure for the three goods equals the national income. Eq (21) is simply the market-clearing condition. Note that (20) and (21) contain two unknowns: u and q. Thus, the model is determined and can be solved for the impact of economic growth.

The analysis proceeds as follows. Totally differentiating (20) and (21) with the aid of (17), we obtain

$$E_u du + L_X(w_Y - w_Z)\ (\partial\lambda / \partial q)dq = [R_\alpha - L_X(w_Y - w_Z)(\partial\lambda / \partial\alpha)]d\alpha, \tag{22}$$

$$E_{qu} du - (e+s)\ (Z / q)dq = \tilde{Z}_\alpha\, d\alpha, \tag{23}$$

where $E_u = \partial E / \partial u$ and $E_{1u} = \partial E_1 / \partial u$. Note that $e = -(q / Z)\ (\partial E_q / \partial q)$ describes the consumption substitution for a given utility in response to a change in q, and $s = (q / Z)\ (\partial \tilde{Z} / \partial q)$ denotes the substitution in production in response to a change in q along the transformation frontier.

The effect of economic growth on the price of services can be obtained by solving (22) and (23) as

$$dq / d\alpha = \{-q\,\tilde{Z}_\alpha + m\ [R_\alpha - L_X(w_Y - w_Z)\ (\partial\lambda / \partial\alpha)]\ \} / \Delta, \tag{24}$$

where $m = qE_{qu} / E_u$ and $\Delta = Z(e+s) + mL_X(w_Y - w_Z)(\partial\lambda / \partial q)$. Since the expenditure function is homogeneous of degree one in goods prices, m expresses the

marginal propensity to consume the services and lies in [0, 1]. Assuming stability, $w_Y \geq w_Z$, thus $\Delta > 0$.

There are clearly two parts of the impact of economic growth on the price of services. The first term on the RHS of (24) denotes a supply response, while the second term represents a demand response to the price of service through the income effect.

Recall that for the rich country, $\tilde{Z}_\alpha = \partial \tilde{Z} / \partial \alpha < 0$. Hence, the negative supply, coupled with the positive demand response, pushes up the price of services. As a result, economic growth unambiguously raises the service price.

However, the effect of technical progress on the service price in the poor country is far from cut and dried. While the demand response through the increased consumption of services pushes up the price of services, the supply response as shown earlier is ambiguous. Economic growth thus raises the price of services if the positive-demand response dominates the supply response. However, technical progress may lower the price of service if a positive-supply response outweighs the demand response. The wage differentials in the poor country give rise to the possibility of lower service prices. Thus, we can state the following proposition:

***Proposition**: In the presence of wage differentials, technical progress may lower the service price of the poor country; however, technical progress always raises the service price of the rich country.*

Next, we examine the welfare implications of economic growth for the poor and the rich country. From (22), we have

$$E_u du / d\alpha = R_\alpha - L_X(w_Y - w_Z)\,(\partial\lambda / \partial\alpha) \\ - L_X(w_Y - w_Z)(\partial\lambda / \partial q)(dq / d\alpha). \qquad (25)$$

Eq (25) constitutes the key equation for analyzing the welfare effect of technical progress. The first term on the RHS of (25) is the direct gain of technical progress. The second term captures the welfare gain resulting from the growth-induced direct labor reallocation. And the last term shows the welfare effect due to further labor reallocation via the induced shift in the service price. Note that the first two terms capture the income effect. This can easily be seen by differentiating the revenue equation $R\ (= pX + qZ + Y)$ with respect to α: $\partial R / \partial \alpha = R_\alpha - L_X(w_Y - w_Z)(\partial\lambda / \partial\alpha)$, which is always positive.

We are ready to deduce the welfare impact for the rich and the poor country.

Consider first the rich country where $w_Y = w_Z$. The second and the third term drop out, and only the first term prevails in (25). Hence, we have $E_u du / d\alpha = R_\alpha > 0$. There are no direct or indirect labor reallocation effects. Growth, as expected, always improves welfare in the absence of distortions and the terms of trade effect.

The welfare impact for the poor country is a bit complex, however. The effect of technical progress here also depends upon the sign of $dq / d\alpha$ in addition to the magnitude of $(w_Y - w_Z)$. Let us consider two cases of interest. First, growth results in lower service price, $dq / d\alpha < 0$. It is clear that $du / d\alpha > 0$; technical progress improves welfare. Second, growth leads to a higher service price, $dq / d\alpha > 0$. The higher service price results in a negative labor reallocation effect. Thus, despite the positive income effect, welfare can still be reduced if the unfavorable labor reallocation effect is sufficiently strong. A sufficient condition for growth to be immiserizing for the poor country can be easily ascertained. Substituting (24) into (25) yields

$$\begin{aligned} E_u du / d\alpha = \{ & Z(e+s)[R_\alpha - L_X(w_Y - w_Z)\ (\partial\lambda / \partial\alpha)] \\ & + q\tilde{Z}_\alpha\, L_X(w_Y - w_Z)(\partial\lambda / \partial q)\} / \Delta. \end{aligned}$$

Thus, a sufficient condition for immiserizing growth to occur is

$$\tilde{Z}_\alpha < -Z(e+s)[R_\alpha - L_X(w_Y - w_Z)\ (\partial\lambda / \partial\alpha)] / [qL_X(w_Y - w_Z)(\partial\lambda / \partial q)] < 0.$$

Note that the larger the $\partial\lambda / \partial q$, the greater the likelihood that immiserizing growth will occur.

IV. Conclusions

We have developed a three-goods general equilibrium framework for examining the effects of economic growth on the service price and welfare of the poor and rich country. Our analysis suggests that the existence of intersectoral wage differential in the poor countries can explain why the service price is lower in these countries. We also show that it is the service price that plays a central role in determining the welfare effects of growth. Without wage differentials, economic growth always improves the welfare of the rich country; however, growth can be immiserizing for the poor country suffering from wage differentials.

Appendix

1. Stability

We derive the stability condition of the three-sector general equilibrium model. Following Dei [1985], we assume that the adjustment process for services is

$$\dot{q} = aD(q),$$

where the dot is the time derivative, a is a positive constant and $D = E_q(p,\ q,\ u) - \tilde{Z}(p,\ q,\ \alpha)$ is the excess demand for services. From (22), we can obtain that u is a function of q. By keeping α and p constant, we can take a linear approximation of the above adjustment process around the equilibrium point q^e as:

$$\dot{q} = a(dD / dq)\ (q - q^e).$$

Hence, the necessary and sufficient condition for stability of this system is

$$dD / dq < 0.$$

From (22) and (23), we obtain

$$dD / dq = -q / \Delta.$$

Hence, $\Delta > 0$ assures the stability of the system. A sufficient condition for stability is $w_Z \leq w_Y$.

2. Comparative Statics

Totally differentiating the equations (5), (8), (9), (10) and (11), we have

$$\begin{bmatrix} pX_{LL} & 0 & 0 & 0 \\ q\lambda Z_{LL} & 0 & qL_x Z_{LL} & -1 \\ 0 & (1+\lambda)Y_{LL} & (w_Y - w_Z) & -\lambda \\ (1+\lambda) & 1 & L_X & 0 \end{bmatrix} \begin{bmatrix} dL_X \\ dL_Y \\ d\lambda \\ dw_Z \end{bmatrix} = \begin{bmatrix} -pX_{L\alpha}d\alpha \\ -Z_L dq \\ 0 \\ 0 \end{bmatrix}$$

The determinant of the coefficient matrix is given by

$$D = -pX_{LL}\{(1+\lambda)L_X Y_{LL} + q\lambda L_X Z_{LL} - (w_Y - w_Z)\}$$

which is negative by virtue of the stability condition $w_Z \le w_Y \le w_X$.

Using Cramer's rule, we can solve for

$$\partial L_X / \partial q = 0,$$

$$\partial L_X / \partial q = -\lambda p Z_L L_X X_{LL} / D < 0,$$

$$\partial \lambda / \partial q = \lambda p Z_L X_{LL} / D > 0$$

$$\partial w_Z / \partial q = p Z_L X_{LL}\{-(1+\lambda)L_X Y_{LL} + (w_Y - w_Z)\} / D > 0,$$

$$\partial L_X / \partial \alpha = p X_{L\alpha}\{(1+\lambda)L_X Y_{LL} + \lambda q L_X Z_{LL} - (w_Y - w_Z)\} / D > 0,$$

$$\partial L_Y / \partial \alpha = p X_{L\alpha}\{-\lambda q L_X Z_{LL} + (1+\lambda)(w_Y - w_Z)\} / D < 0,$$

$$\partial \lambda / \partial \alpha = -p X_{L\alpha}\{Y_{LL}(1+\lambda)^2 + q^2 Z_{LL}\} / D < 0,$$

$$\partial w_Z / \partial \alpha = -pq X_{L\alpha} Z_{LL}\{(1+\lambda)L_X Y_{LL} + \lambda(w_Y - w_Z)\} / D \gtrless 0.$$

With fixed labor endowment in the economy, $\partial L_X / \partial q = 0$, coupled with $\partial L_Y / \partial q < 0$, implies $\partial L_Z / \partial q > 0$. It follows that $\partial \lambda / \partial q > 0$. Since capital is sector-specific in the service sector, $\partial L_Z / \partial q > 0$ must give rise to $\partial \tilde{Z} / \partial q > 0$. Thus, the price-output response in the services sector is normal. We can also readily deduce $\partial \tilde{X} / \partial q = 0$ and $\partial \tilde{Y} / \partial q < 0$. Moreover, we can obtain $\partial L_Z / \partial \alpha = -pX_{L\alpha}\{(1+\lambda)L_X Y_{LL} + \lambda(w_Y - w_Z)\} / D \gtrless 0$, which is consistent with $\partial w_Z / \partial \alpha \gtrless 0$.

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