

Macroeconomic Adjustment with Segmented Labor Markets

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Abstract

This paper analyzes the macroeconomic effects of fiscal and labor market policies in a small open developing economy. The basic framework considers an economy with a large informal production sector and a heterogeneous work force. The labor market is segmented as a result of efficiency considerations and minimum wage laws. The basic model is then extended to account for unemployment benefits, income taxation, and imperfect labor mobility across sectors. Under perfect labor mobility, a permanent reduction in government spending on nontraded goods leads in the long run to a depreciation of the real exchange rate, a fall in the market-clearing wage for unskilled labor, an increase in output of traded goods, and a lower stock of net foreign assets. A permanent reduction in the minimum wage for unskilled workers improves competitiveness, and expands the formal sector. A reduction in unemployment benefits has a positive effect on output of tradable goods by lowering both the level of efficiency wages and the employment rent of skilled workers.

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1 Introduction

Studies of urban labor markets in developing countries have come to distinguish between the formal and informal sectors on the basis of whether employment relationships are subject to various labor market regulations and other institutional constraints.¹ In the formal sector, which consists of medium- and large-scale enterprises, workers are entitled to a variety of benefits, such as minimum standards for working conditions, job security provisions, social security and disability protection, pension plans, and health insurance. Skilled and unskilled workers are hired through formal contracts, with labor unions (or collective bargaining mechanisms) playing in some countries an important role in the determination of wages. Firms usually comply with minimum wage laws, although the degree of compliance may vary considerably across production sectors. By contrast, in the informal segment of the urban labor market—which includes self-employed individuals and small privately-owned enterprises producing mainly services and other nontradables—labor regulations are usually not enforced. Activities in this sector rely mostly on the direct provision of labor services by owners and their families. Paid labor is used (usually without any formal employment contract) only occasionally. Although the informal labor market is characterized by free entry, job insecurity is pervasive, wages are highly flexible, and workers get very few benefits from their employers. Minimum wage laws do not apply or are not consistently enforced, and collective bargaining plays a limited role in the determination of wages.

By most accounts, the informal sector represents a sizable proportion—between 30 and 60 percent—of economic activity and total employment in developing countries, particularly in some parts of Asia, the Middle East, and Sub-Saharan Africa.² A consequence of the formal-informal dualism induced by the lack of enforcement of government legislation is the segmentation of the urban labor market, which plays a crucial role in explanations of urban

¹See, for instance, Mazumdar (1983) and Turnham (1993). Rural labor markets, which account for a substantial component of employment in many developing countries, are characterized by a large share of self-employed persons and unpaid family workers. Wage earners bound by explicit contracts are also employed in agriculture, but is a less common occurrence.

²See Rosenzweig (1988) and Turnham (1993). Empirical estimates usually measure employment in the informal sector as the sum of self-employed workers, unpaid family workers, and domestic workers. Existing data must, however, be interpreted with care.

poverty, unemployment and underemployment in developing countries. Labor market segmentation can be defined as a situation where, because of barriers—institutional or otherwise—to occupational mobility between sectors, a worker in the “low-wage” sector does not have full access to a job in the “high-wage” sector held by an observationally identical worker (Taubman and Wachter, 1986). If there were no barriers, workers in the low-wage sector would enter the high-wage sector and bid wages down until earnings across sectors were equalized. More succinctly, labor market segmentation implies persistent wage differentials for observationally identical workers.

The best-known model of labor market segmentation in developing countries was developed by Harris and Todaro (1970), in their attempt to explain the persistence of migration from rural to urban areas, despite the existence of widespread urban unemployment. A key feature of the model is the equality of expected (rather than actual) wages in the urban sector and the rural areas as the basic equilibrium condition of the labor market. Harris and Todaro showed that the existence of a binding minimum wage in the urban sector leads, even if the rural labor market is competitive, to a persistent wage differential between the rural and urban sectors and to the emergence of urban unemployment.

In the Harris-Todaro framework, labor is homogeneous and perfectly mobile across sectors. Labor market segmentation emerges as a result of the government imposing a minimum wage in urban areas. However, an important feature of urban labor markets in developing countries—and, indeed, of labor markets everywhere—is the fact that workers are endowed with different skills, and may face short-term constraints on mobility across sectors as well as across different skill categories. In addition, wage differentials may emerge not only as a result of institutional constraints but also as a consequence of firms’ wage-setting decisions aimed at enhancing productivity of a given category of workers. Labor force heterogeneity, imperfect sectoral mobility, and productivity considerations add new dimensions to the analysis of labor market segmentation. In particular, they provide important elements for examining potential spillover effects across different segments of the labor market, and the behavior of sectoral wages. Accounting for these features has important implications for understanding the effects of macroeconomic and structural policy shocks in developing countries.³

³The implications of labor market segmentation in the absence of worker heterogeneity have been examined by Agénor and Santaella (1998) and Demekas (1990) in a short-term

The purpose of this paper is to analyze the effects of fiscal and labor market policies on output, wages, and unemployment in a dynamic, general equilibrium model of a small open developing economy with a large informal sector and segmented labor markets. Our analysis is based in part on the prevalent view among development economists that the absence—or lack of enforcement—of government regulations is the defining characteristic of the informal sector. Section II develops the basic framework, which distinguishes between skilled and unskilled labor and assumes perfect mobility across sectors, and examines the effect of changes in government expenditure and the minimum wage paid to unskilled workers on the composition of employment. Section III introduces income taxation and unemployment benefits, and analyzes how these modifications affect the determination of equilibrium wages, productivity, and employment. Section IV extends further the basic framework to consider the case where mobility of unskilled workers between the formal and informal sectors is imperfect. Finally, Section V summarizes the main implications of the paper and discusses some possible extensions of the analysis.

2 A Basic Framework

Consider a small open economy in which there are three types of agents: producers, households, and the government. The economy consists of two sectors: a formal sector, which produces a traded good using skilled and unskilled labor, and the informal sector, which produces a nontraded good, using only unskilled labor.⁴ However, skilled workers may choose to accept employment as unskilled workers in the informal sector. The relative price of the traded good (the real exchange rate) is determined by the equilibrium condition of the nontraded good market.

The capital stock in each sector and the composition of the labor force between skilled and unskilled workers are assumed fixed during the time frame of the analysis, while workers are initially perfectly mobile across sectors. A minimum wage for unskilled labor imposed by government that exists, but

macroeconomic context, and by Edwards (1988) in the context of trade and structural reforms.

⁴Assuming that the formal sector produces also a nontraded good (such as public services, for instance) would provide a valuable extension of the present framework, but would complicate the analysis.

is enforced only in the formal sector. The wage rate for skilled labor in the formal sector is assumed set on the basis of efficiency considerations (taking into account workers' opportunity earnings), leading to an above-equilibrium wage.⁵ By contrast, wages of unskilled workers in the informal sector are fully flexible. Once employment decisions for both categories of labor are taken by producers in the formal sector, the informal sector absorbs all unskilled workers that are not hired in the formal sector.⁶ If, in addition, skilled workers who are unable to find a job in the formal sector are willing to work as unskilled labor in the production of the nontraded good in the informal sector, unemployment will not emerge—although labor may be inefficiently allocated. Equilibrium of the informal labor market obtains once total supply and demand are equalized through wage adjustment.⁷

Households consume both traded and nontraded goods produced in the formal and informal sectors, supply labor inelastically and hold a traded bond, which bears a real rate of return determined on world markets. Domestic agents can borrow and lend freely at that rate, which varies inversely with the economy's stock of bonds as well as the composition of domestic output. The government consumes traded and nontraded goods, and finances its expenditure by varying lump-sum taxes on households. Finally, wage and employment expectations—which affect, as discussed in section IV, the decision to migrate across sectors—are assumed to depend on prevailing conditions in the labor market.

⁵There is by now a voluminous literature in developed countries that views involuntary unemployment as the consequence of efficiency wages. See Weiss (1990) and, for a more critical view, Carmichael (1990).

⁶Formal sector employment provides a nonpecuniary benefit—such as an enhanced social status—which induces unskilled workers to search for a job in that sector first. This implies that in equilibrium the informal sector wage can be higher than the legal minimum wage.

⁷The dichotomy in wage formation can be justified by assuming that efficiency considerations result from firms' desire to avert shirking (as discussed below) and minimize the cost of monitoring workers' effort. Assume also, as argued in the introduction, that the formal sector consists essentially of "large" firms, while the informal sector consists only of "small" firms. A plausible conjecture is therefore that small firms can monitor nearly costlessly the level of effort produced by their workers, thus obviating the need to pay efficiency wages.

2.1 Production, effort, and the labor market

The production technology in the formal sector is given by⁸

$$Q_F = Q(eL_S; L_U); \quad (1)$$

where Q_F denotes output, e the level of effort per skilled worker (which is bounded between 0 and unity by an appropriate choice of units), L_S employment of skilled workers and L_U employment of unskilled workers, both measured in natural units. Production takes place under decreasing returns to both categories of labor, which are assumed to be imperfectly substitutable. The domestic price of formal sector output is equal to the constant nominal exchange rate E , if the world price of traded goods is set to unity.

The first step in the analysis of production decisions in the formal sector is to determine the level of effort that firms will demand from skilled workers. Assume that consumption and effort decisions are separable, and that the decision to provide effort depends only on the wage earned w and the disutility of effort. All workers share the same instantaneous utility function $u(w; e)$ which, after appropriate normalizations, is defined as $\ln[\omega(1 - e)^{1-\omega}]$, where $0 < \omega < 1$.⁹ Let μ denote the probability (per unit time) that a skilled worker is detected shirking, in which case he is fired and must seek employment as an unskilled worker in the informal sector. The level of effort provided by a highly-qualified worker is either positive (when employed and not shirking) or zero (when shirking while employed, or when working in the informal sector). The optimal effort level of a skilled worker is determined so that the expected utility derived from working is at least equal to the expected utility of shirking:

$$\omega \ln w_S + (1 - \omega) \ln(1 - e) \geq \mu \ln w_I + (1 - \mu) \omega \ln w_S; \quad (2)$$

where w_S denotes the product wage of skilled workers in the formal sector, and w_I the real wage (measured in terms of traded goods) earned by unskilled workers in the informal sector. The left-hand side in expression (2) measures the expected utility derived by a skilled worker who is not shirking and provides a level of effort equal to e , while the right-hand side measures the

⁸For convenience, time subscripts are omitted in what follows. Except otherwise indicated, the total derivative of a function of a single argument is denoted by a prime.

⁹The quantity $1 - e$ could be viewed here as measuring leisure, although the supply of hours is assumed fixed for both categories of workers (see below).

expected utility of a shirking worker as a weighted average of the wage earned if caught shirking and ...red (with probability $\frac{1}{4}$), and if not caught (with probability $1 - \frac{1}{4}$)—with a zero level of effort in both cases.¹⁰

The level of effort demanded by firms is assumed to be such that skilled workers are indifferent between shirking and not shirking—in which case workers choose not to shirk—so that condition (2) holds with equality. Solving for the required level of effort yields

$$e = 1 - \left(\frac{w_S}{w_U}\right)^{\frac{1}{4}}; \quad \frac{\partial e}{\partial w_S} > 0; \quad \frac{\partial e}{\partial w_U} < 0 \quad (3)$$

Equation (3) shows that productivity of skilled workers depends positively on the real wage in the formal sector and negatively on the real wage in the informal sector, which measures the opportunity cost of effort. It can readily be established that the marginal effect of an increase in the real wage in the formal sector on effort is positive but decreasing, and that an increase in the probability of getting caught shirking raises the level of effort.¹¹

The representative producer in the formal sector chooses employment levels and the wage paid to skilled workers so as to maximize its real profits, π_F . Using equations (1) and (3) and assuming that firms incur no hiring or ...ring costs, the decision problem is thus

$$\max_{L_S, L_U} \pi_F = Q_F L_S^{\frac{1}{2}} \left[1 - \left(\frac{w_S}{w_U}\right)^{\frac{1}{4}}\right]^{\frac{3}{4}} L_U - w_S L_S - w_U L_U;$$

where w_U denotes the legal minimum wage (measured in terms of traded goods) for unskilled workers, which is assumed binding in the formal sector.

¹⁰Our formalization of the decision process that workers face shares some common features with the well-known shirking model of Shapiro and Stiglitz (1984). It differs, however, in two aspects. First, the choice of an effort level in our framework is continuous rather than discrete. Second, only current market conditions matter here, while in the Shapiro-Stiglitz framework workers form their decisions on the basis of the expected discounted utility stream associated with alternative options. We have provided in a different context (Agénor and Aizenman, 1997) an extension of the Shapiro-Stiglitz model to the labor market setup considered here.

¹¹A more general derivation of an effort function based on expected utility maximization is presented by Pisauro (1991). In his analysis, the worker's utility function is a) additively separable in effort and consumption, b) linear in effort, and c) concave in income. This specification leads to an effort function which depends on the unemployment rate, and is not homogeneous of degree zero in the "own" wage and the alternative wage.

The first-order conditions for this optimization problem are:

$$\left[\frac{\partial Q_F}{\partial (eL_S)} \right] \left[1 - i \left(\frac{w}{w_S} \right)^\alpha \right] = w_S; \quad (4)$$

$$\left[\frac{\partial Q_F}{\partial (eL_S)} \right] \left(\frac{w}{w_S} \right)^\alpha = \alpha i w_S; \quad (5)$$

$$\partial Q_F = \partial L_U = w_U; \quad (6)$$

Optimality conditions (4) and (5) can be solved to yield:

$$w_S = \frac{1}{\alpha} w_U; \quad \frac{1}{\alpha} > (1 + \alpha)^{1-\alpha} > 1; \quad (7)$$

which indicates that, in equilibrium, firms in the formal sector always set the efficiency wage for skilled workers at a higher level than the opportunity cost of effort.¹²

A graphical determination of the efficiency wage is shown in Figure 1.¹³ Note that skilled workers' equilibrium wage depends only on the going wage in the informal sector, and not on the minimum wage for unskilled workers in the formal sector. This is because the only employment opportunity available to a skilled worker who loses his job in the formal sector as a result of inadequate performance is to join the informal sector labor force.¹⁴

Equations (3) and (7) imply that in equilibrium effort is constant at $e = 1 - \frac{1}{\alpha} i \alpha^{-1} \alpha = (1 + \alpha)$. Substituting the optimal value of w_S from equation (7) in equation (4), and solving the resulting equation together with (6) yields the demand functions for skilled and unskilled labor in the formal sector:

$$L_S^d = L_S^d(w_U; w_U); \quad L_U^d = L_U^d(w_U; w_U); \quad (8)$$

¹²Equations (4) and (5) also yield the standard Solow condition, which indicates that in equilibrium the elasticity of effort with respect to the product wage must be equal to unity. See Weiss (1990).

¹³If we had assumed that skilled workers provide a minimum level of effort e_m when shirking while employed in the formal sector or when hired in the informal sector, the term $(1 - i^\alpha) e_m$ would have appeared on the right-hand side of equation (2) and the level of effort that would obtain when the wage ratio is unity would be e_m instead of 0.

¹⁴To avoid frictions among their employees, firms in the formal sector do not use highly-qualified workers in positions requiring limited skills. See Agénor and Aizenman (1997) for a more detailed discussion of this point.

An increase in the informal economy wage reduces the demand for skilled labor but has an ambiguous effect on the demand for unskilled labor in the formal sector. A rise in the real wage in the informal sector increases in the same proportion the efficiency wage paid to skilled workers in the formal sector, thus maintaining effort constant. The resulting increase in labor costs lowers the demand for both categories of workers. In addition, however, firms tend to substitute unskilled labor for skilled labor, thus raising the demand for unskilled workers. An increase in the minimum wage reduces the demand for unskilled workers but has an ambiguous effect on the demand for skilled workers for the same reasons. As shown in Appendix I, a sufficient condition for both ambiguities to disappear and ensure negative partial effects is that the elasticity of substitution between skilled and unskilled labor in the production of traded goods be sufficiently small—a fairly plausible assumption in practice.

Substituting (7) and (8) in (1) yields

$$Q_F^S = Q_F^S(\omega_U^i; \omega_U^a); \quad (9)$$

which indicates that, given the condition discussed above, the partial equilibrium effect of an increase in either the minimum wage for unskilled workers or wages in the informal sector on output of traded goods is unambiguously negative.

Production in the informal sector is subject to decreasing returns to unskilled labor and is written as

$$Q_I = Q_I(L_I); \quad Q_I^0 > 0; \quad Q_I^{00} < 0; \quad (10)$$

with real profits (in terms of traded goods) given by

$$\pi_I = z^i Q_I(L_I) - \omega_U L_I;$$

where L_I denotes employment of unskilled workers in the informal sector and z the relative price of traded goods in terms of nontraded goods (hereafter the real exchange rate). Profit maximization yields the familiar equality between marginal revenue and marginal cost, $\omega_U = z^i Q_I^0$, from which labor demand can be derived as

$$L_I^d = Q_I^{0i-1}(z^i \omega_U) = L_I^d(z^i \omega_U); \quad L_I^{d0} < 0; \quad (11)$$

where $z!_1$ measures the product wage in the informal sector. Substituting this result in equation (10) implies

$$Q_1^s = Q_1^s(z!_1); \quad Q_1^{s0} < 0; \quad (12)$$

Real factor income—measured in terms of traded goods—is given by

$$Q = Q_F^s + z!_1 Q_1^s; \quad (13)$$

Let L^s denote total labor supply in the economy, and L_S^s supply of skilled workers. Unskilled labor supply is thus given by $L_U^s = L^s - L_S^s$. As indicated above, firms in the formal sector determine the wage paid to skilled workers and make their employment decisions first, hiring randomly from the existing work force until their optimal demand for labor is satisfied. Skilled workers who are unable to obtain employment in the formal sector become suppliers in the informal labor market; the equilibrium condition of the informal labor market is thus given by

$$L_S^s - L_S^d(!_1; !_U^a) + L_U^s - L_U^d(!_1; !_U^a) = L_1^d(z!_1); \quad (14)$$

which can be solved for the equilibrium value of $!_1$:

$$!_1 = \cdot (z; !_U^a); \quad (15)$$

Equation (15) shows that the informal sector wage is inversely related to the minimum wage and the real exchange rate. An increase in the minimum wage—under the assumption that the degree of substitutability between skilled and unskilled workers is not too high, as shown in equation (A10) of Appendix I—lowers the demand for both categories of workers in the formal sector and increases the supply of labor in the informal sector, exerting downward pressure on wages there. A real exchange rate depreciation dampens the demand for unskilled workers in the informal sector, requiring a fall in wages to maintain equilibrium in the informal labor market.

2.2 Consumption and asset accumulation

Households supply labor in quantity L^s and consume traded and nontraded goods produced by the formal and informal sectors. The representative

household's lifetime discounted utility is given by¹⁵

$$\int_0^{\infty} \ln(c_I^\pm c_F^{1 \mp}) e^{-i^\pm t} dt; \quad \frac{1}{2} > 0; \quad 0 < \pm < 1; \quad (16)$$

where $\frac{1}{2}$ denotes the constant rate of time preference, and c_F (c_I) consumption of traded (nontraded) goods.

Households hold an internationally traded bond, the stock of which, b , evolves over time according to

$$\dot{b} = i^\pm b + Q_I - z^{i^\pm} c_I - c_F - \zeta; \quad (17)$$

where ζ denotes real lump-sum taxes (measured in terms of traded goods), and i^\pm the world interest rate. The interest rate facing the country considered varies inversely with the economy's stock of foreign assets and positively with the long-run ratio of informal and formal sector outputs:¹⁶

$$i^\pm = i^\pm(b; Q_I^S = z Q_F^S); \quad (18)$$

where z , Q_I^S and Q_F^S denote the long-run values of z , Q_I^S and Q_F^S .¹⁷

Households treat Q , z , i^\pm and ζ as given and maximize (16) subject to (17) by choosing a sequence $\{c_I; c_F; b\}_{t=0}^{\infty}$. The solution to this program is characterized by the following familiar conditions:

$$(1 - \pm) c_F = 1; \quad (19)$$

¹⁵For clarity, only the consumption part of households' utility is explicitly specified in equation (16), since consumption and export decisions were assumed to be separable. To simplify calculations, the instantaneous utility derived from total consumption is taken to be logarithmic, while consumption itself is assumed to be a Cobb-Douglas function in the two categories of goods.

¹⁶See Agénor and Santaella (1998) for a discussion of the first effect. The formulation used here captures the idea that the world interest rate faced by a small country is a function not only of the existing level of debt (if the initial value of foreign assets is negative) but also of the potential capacity to repay, which in turn depends on the economy's ability to produce traded goods as opposed to nontraded goods in the long run. See Aizenman (1989b) for a discussion of the role of openness in determining the country-specific interest rate on world markets.

¹⁷For simplicity, we assume $i^\pm(b; \zeta)$ to be continuously differentiable. More generally, the function could have a "kink" at a critical value of the stock of bonds. We also impose $i^\pm(0; \zeta) = \frac{1}{2}$, which fixes the real interest rate, for a zero level of net indebtedness, to the rate of time preference.

$$c_t = \beta z c_F = (1 - \beta); \quad (20)$$

$$\dot{z} = (\beta - \delta) z; \quad (21)$$

in addition to (17) and the transversality condition $\lim_{t \rightarrow \infty} \beta e^{-\delta t} z = 0$, the costate variable associated with the asset accumulation equation, measures the shadow value of wealth.

Equation (19) yields $c_F = c_F^0$, with $c_F^0 < 0$. Substituting this result in equation (20) yields the demand for nontraded goods produced in the informal sector. Using this result together with equation (12), the equilibrium condition of the market for goods produced in the informal sector is given by

$$Q_i^S(z, i) = \frac{\beta z}{1 - \beta} c_F^0 + g_i; \quad (22)$$

where g_i denotes government spending on informal sector goods.

To close the model requires specifying the behavior of the government. Public revenue consists of lump-sum taxes on households, and public spending consists of expenditure on traded and nontraded goods. To ensure solvency, we assume that the government maintains spending levels constant and adjusts lump-sum taxes to balance the budget:

$$z + g_F + i - z = 0; \quad (23)$$

3 Fiscal and Labor Market Policies

We now examine the short- and long-run effects of fiscal and labor market policies. To do so, it is convenient to re-write the model in a more compact form. Substituting equation (15) in equation (9) yields

$$Q_F^S = q_F^S(z; \beta, \delta): \quad (24)$$

A depreciation of the real exchange rate has a positive effect on the supply of traded goods in the formal sector—because it reduces the informal sector wage—but the net effect of an increase in the minimum wage is in general ambiguous. On the one hand, it reduces the demand for unskilled workers, if (as assumed earlier) the degree of substitution between labor categories is limited. On the other hand, it reduces the informal sector wage as well as, through the wage setting equation (7), the efficiency wage earned by skilled

workers, thus raising employment and output. Because the equilibrium exchange rate is also a function of the minimum wage (as shown below), we will examine later on the conditions under which the net, general equilibrium effect can be unambiguously signed.

Substituting equation (15) in the equilibrium condition of the nontraded goods market (equation (22)) yields

$$q_i^s(z; \mu_U) = \frac{z}{1 + \mu_U} c_F(1) + g_i \quad (25)$$

An increase in the minimum wage lowers the demand for both categories of labor in the formal sector, reduces the informal sector wage, and thus raises output. The net effect of a real depreciation on informal sector output is in general ambiguous. A real depreciation raises directly the product wage in the informal sector, thus exerting a negative effect on output. At the same time, however, the induced reduction in the demand for labor in the informal sector tends to lower the real wage earned by unskilled workers (measured in terms of traded goods) in the informal sector. This reduction in the informal sector wage, in addition, lowers the real wage of skilled workers (in order to maintain constant the level of effort) in the formal sector—thus lowering the demand for skilled workers. The increase in the supply of labor in the informal sector is thus compounded. The downward pressure on the real wage earned by unskilled workers may be large enough to dominate the upward direct effect associated with a depreciation of the real exchange rate on the product wage in the informal sector. As shown in Appendix I, the direct effect will dominate if, as assumed before, the elasticity of substitution between skilled and unskilled labor in the production of traded goods is not too large. As also discussed above (see equation (15)), the same condition ensures that an increase in the minimum wage lowers the informal sector wage and thus exerts a positive effect on informal sector output.

Using these results and solving equation (25) yields the equilibrium solution for the real exchange rate:

$$z = z(\tau; g_i; \mu_U) \quad (26)$$

Substituting equations (13), (22), (23) and (26) in equation (17) yields

$$b = i^a(b; Q_i^s = zQ_F^s) + q_F^s [z(1; g_i; \mu_U); \mu_U] + c_F(1) + g_F \quad (27)$$

which determines the rate of accumulation of traded bonds. Finally, equation (21) can be rewritten as, using (18):

$$\dot{b} = \frac{1}{b} \left[i^* (b; Q_F^S = Z Q_F^S) \right] \quad (28)$$

Equations (27) and (28) determine the behavior of foreign assets and the marginal utility of wealth over time. Given the solution for \dot{b} , equation (26) determines the equilibrium level of the real exchange rate.

A linear approximation around the steady state to equations (27) and (28) yields

$$\begin{bmatrix} \dot{z} \\ \dot{b} \end{bmatrix} = \begin{bmatrix} 0 & i^*_{z} \\ (\partial Q_F^S / \partial Z) z_1 & i^*_{b} + b (\partial i^* / \partial b) \end{bmatrix} \begin{bmatrix} z \\ b \end{bmatrix} \quad (29)$$

where z^* and b^* denote the steady-state solutions of the system. We will assume in what follows that $d(i^*b) = db > 0$, or that the net effect of an increase in the economy's stock of foreign assets is a rise in interest income, or equivalently, if b is initially negative, that the net effect is an increase in interest payments. This assumption follows from the observation that it is generally inefficient for a small country to operate in a region in which the supply of credit is backward-bending (see Aizenman, 1989a). The system described by (29) is locally saddlepoint stable.¹⁸ The steady-state equilibrium is depicted in Figure 2. Curves $[\dot{z} = 0]$ and $[\dot{b} = 0]$ give combinations of z and b for which the marginal utility of wealth and the stock of bonds remain constant. The negatively-sloped saddlepath SS leads to point E, the steady-state equilibrium.¹⁹

Consider a permanent, unanticipated reduction in government spending on nontraded goods. The dynamics of adjustment are illustrated in Figure 3, in which we assume that initially the country considered is a net debtor. A permanent reduction in government spending implies that there is an incipient excess supply of nontraded goods (for a given level of foreign indebtedness), inducing a real depreciation—a drop in the relative price of nontraded goods. Furthermore, the long-term openness of the country improves, reducing the interest rate i^* facing the country. For a given marginal

¹⁸ Given our sign assumptions, the determinant of the matrix of coefficients in equation (29) is negative. Note that this condition holds irrespective of the value taken by $d(i^*b) = db$.

¹⁹ The slope of the $[\dot{b} = 0]$ curve would be positive if we had assumed that $d(i^*b) = db < 0$. But since the slope of SS does not depend on this derivative, the dynamics of the model would remain qualitatively the same.

utility of wealth there is an incipient current account surplus, which induces a leftward shift in the $[b = 0]$ curve. The improvement in the creditworthiness of the country—which results from the increase in the long-run ratio of output of traded goods relative to output of nontraded goods, as discussed below—implies that the long-run equilibrium calls for higher indebtedness, shifting the $[1 = 0]$ curve also leftward. The new long-run equilibrium is point E^0 , with the associated saddlepath denoted S^0S^0 . On impact, both the drop in the interest rate facing the country and the drop in the relative price of non-traded goods increase the consumption of both types of goods, reducing the shadow value of wealth and moving the economy in the short-run to point A. The move from point E to point A is associated with a reduction in the production of nontraded goods, a fall in the informal sector wage (see equation (15)), and an increase in the production of traded goods. However, the increase in consumption of traded goods exceeds the increase in production of the formal sector, and the net effect is a current account deficit. Over time, the external imbalance increases gradually the indebtedness of the country, moving the economy from point A to point E^0 . In the transition towards the new long-run equilibrium, the real exchange rate depreciates gradually while consumption of traded goods falls, in order to accommodate the larger deficit in the services account.

Consider now a permanent, unanticipated reduction in the minimum wage for unskilled workers. As discussed earlier, the fall in the minimum wage affects production in the formal sector via two channels. The direct effect is to increase the demand for unskilled workers in the formal sector, thus increasing production. The indirect effect is a reduction in labor supply in the informal sector, which therefore leads to an increase in the informal sector wage. This in turn translates, through the efficiency wage-setting condition (7), into an upward adjustment in the real wage earned by skilled workers. Thus, while the direct effect increases employment of unskilled workers in the formal sector, the indirect effect works toward a reduction in employment of skilled workers. In Appendix I we derive the sum of these effects, and show that there is a strong presumption that the direct effect will dominate.²⁰ Hence, the presence of efficiency wages and segmented labor markets does

²⁰More precisely, we show in Appendix I (under the plausible assumption that the legal minimum wage is lower than the efficiency wage earned by skilled workers) that the direct effect dominates as long as the share of the informal sector is large, or if the substitutability between skilled and unskilled workers is not too large. The latter assumption is particularly likely to hold in practice.

not alter the neoclassical presumption in the two-sector framework considered here: a reduction in the minimum wage that is enforced only in the formal sector improves the competitiveness of the country, leading to an expansion of the formal sector and a contraction of the informal sector. The extent to which this result continues to hold under imperfect labor mobility is discussed below.

The “pro-trade bias” associated with the drop in the minimum wage implies that the adjustment path it induces will be qualitatively similar to the transitional dynamics depicted in Figure 3. The long-run reduction in the relative size of the informal sector improves the creditworthiness of the country, shifting the curve [$\pi = 0$] leftward. Similarly, the incipient excess supply of nontraded goods induces a real depreciation (that is, an increase in z), thereby shifting the [$b = 0$] curve leftward. Hence, the long-run effects of a reduction in the minimum wage are also qualitatively similar to those induced by a fall in government spending on goods produced in the informal sector: both imply a pro-trade bias.

4 Taxation and Unemployment Benefits

In developing countries, taxation affects mostly firms and workers operating in the formal sector—in a manner similar to labor market regulations. While this asymmetric feature of tax systems in the developing world may well be the optimal policy response given administrative and other institutional constraints, it may lead to severe distortions in supply and demand decisions in the short run. In this section, we generalize the framework developed above so as to account for direct income taxation and unemployment benefits for skilled workers in the formal sector, and examine how these modifications affect the determination of sectoral wages, productivity and the composition of employment.²¹

Firms in the formal sector determine as before the optimal levels of employment of both categories of labor as well as skilled workers' wages, without facing a binding quantity constraint in either segment of the labor market. However, instead of assuming that skilled workers who are not hired in the formal sector systematically enter the labor force in the informal sector, we

²¹The analysis is further extended in the next section to account for the existence of unemployment benefits for unskilled workers in the formal sector and imperfect labor mobility.

now assume that unsuccessful applicants choose to remain unemployed while receiving a government-financed unemployment benefit.²² The unemployment insurance scheme is financed in part by a tax on wage income, levied at the rate $0 < \tau < 1$ on skilled workers employed in the production of traded goods.

Because skilled workers are now faced with a different set of opportunity costs, the first step in examining the implications of the foregoing assumptions is to determine the optimal level of effort. Suppose for the moment that the unemployment benefit, denoted μ , takes the form of a flat real wage. As before, optimal effort is determined so that the expected utility derived from working without shirking must be equal in equilibrium to the expected utility derived if caught shirking. Condition (2) becomes now

$$\tau \ln[(1 - \tau)w_s] + (1 - \tau) \ln(1 - e) = \tau \ln \mu + (1 - \tau) \ln[(1 - \tau)w_s]; \quad (30)$$

so that

$$e = 1 - \frac{\mu}{(1 - \tau)w_s}; \quad (31)$$

which indicates that skilled workers' effort depends negatively on the rate of income taxation and positively on the level of unemployment benefits.

Assuming for simplicity that government transfers consist only of benefit payments to unemployed workers in the formal sector, the government budget constraint (23) becomes

$$\tau w_s L_S^d - \mu(L_S^s - L_S^d) - g_F - z^{i-1} g_i = 0; \quad (32)$$

Using equation (31), it is straightforward to verify that in equilibrium the efficiency wage for skilled workers is equal to

$$w_s = \frac{\mu}{1 - \tau}; \quad (33)$$

²² Assuming that only a given proportion of excess supply in the market for skilled workers enters the unskilled labor force would not have any qualitative effect on the analysis. We do not elaborate here on reasons why skilled workers may refuse to work as unskilled labor in the informal economy. Important considerations however are likely to be the loss of social prestige that such a decision may entail, the potentially adverse signaling effect towards future employers, search efficiency (it may be easier to look for a formal-sector job while being unemployed), the perception that human capital may deteriorate rapidly (thus hampering re-entry in the skilled labor force), or that the wage in the informal sector provides less utility than a combination of leisure and unemployment benefit. Thus, the assumption that the unemployment benefit exceeds the market-clearing wage is a sufficient but not necessary condition for unemployment to emerge.

and that the supply function of the formal sector becomes

$$Q_F^S = Q_F^S \left(\frac{\mu}{1 - \mu} \right); \quad (34)$$

where both partial derivatives are negative, given our assumption about the degree of substitutability between labor categories.

The informal sector wage now depends indirectly on the efficiency wage for skilled workers (because it affects the demand for unskilled workers in the formal sector) but is independent of the level of employment of skilled workers—because there is no “spillover” effect resulting from a job shortage for that category of labor in the formal economy. The equilibrium condition between supply and demand for labor in the informal sector is now given by

$$L_U^S \left(\frac{\mu}{1 - \mu} \right) = L_U^D(z); \quad (35)$$

which can be solved for z .

Using the budget constraint (32), and equations (34), (35) and the dynamic equations driving the economy, we can now examine the effect of a modification of the income tax rate and unemployment benefits. For a given level of lump-sum taxes τ , the government budget constraint (32) implies a link between the income tax on wages, and the level of unemployment compensation for skilled workers. As derived formally in Appendix II, this relationship is not monotonic. The taxation-unemployment benefit curve has in general an inverted U-shape in the μ - z space, which is displayed in Figure 4, for a given level of government spending. Each wage benefit level is thus supported by two tax rates. We can neglect the higher one, obtaining an efficient frontier, defined by the leftward portion of the curve. At low levels of the wage benefit, the demand for skilled labor is inelastic, and the efficient frontier is downward sloping: lower unemployment compensation reduces the skilled workers' wage (through the efficiency condition (33)) and, for a given tax rate, reduces tax revenue. Hence a higher tax rate is required. As we reach a level of elasticity that is high enough, the curve becomes upward sloping—which corresponds to the stage where lower unemployment compensation reduces the efficiency wage paid to skilled workers, which in turn raises employment by an amount that is large enough to reduce the total revenue needed to support the unemployment compensation scheme. Thus, as long as the elasticity of the demand for skilled workers (with respect to their

own wage) is sufficiently large, higher unemployment compensation requires a higher tax rate for a given level of employment of skilled workers.

Assume now that the economy operates on the upward-sloping portion of the efficient frontier of the taxation-unemployment benefit curve, that is, between points A and B in Figure 4. A lower level of unemployment compensation will therefore raise the level of employment of skilled workers, as a result of two complementary effects. First, it reduces directly the efficiency wage by lowering the opportunity cost of skilled workers' effort. Second, it reduces the tax rate on skilled workers—as a result of the government budget constraint—thus reducing the producer real wage (see equation (33) for both effects). The net outcome is a higher level of employment of skilled labor. This generates spillover effects, increasing the demand for unskilled labor, bidding the informal sector wage up and reducing labor absorption in the informal sector. Thus, a lower level of unemployment benefits for skilled workers leads to an expansion of the formal sector and a contraction of the informal economy. The dynamic adjustment process is, again, qualitatively similar to the one depicted in Figure 3.

An alternative formulation of the unemployment benefit scheme is to assume that the level of compensation is set as a function of the minimum wage for unskilled workers and the after-tax wage for skilled workers:

$$\mu = \frac{w}{1 - \tau} + \lambda(1 - \tau)w_s; \quad 0 < \lambda < 1; \quad (36)$$

The relevant condition for deriving the effort function is given by an equation similar to (30). Using (36) to substitute out for μ yields

$$e = 1 - \lambda + \frac{\frac{w}{1 - \tau}}{(1 - \tau)w_s}; \quad (37)$$

where the level of effort depends now not only on the rate of taxation, but also directly on the unemployment benefit rate λ , as well as the minimum wage for unskilled workers. Solving as before the optimization problem faced by producers in the formal sector yields a relation of the form

$$(1 - e)^{1-\alpha} [(1 - e) - e]^\alpha \lambda (1 - e) = 0;$$

where e denotes the equilibrium level of effort. It can be shown that

$$e = e(\lambda, \frac{w}{1 - \tau}); \quad (38)$$

which indicates that in equilibrium, effort depends negatively on the unemployment benefit rate and positively on the parameter θ —and thus, from equation (3), positively on the probability of getting caught shirking—but depends neither on the income tax rate (as in the previous case) nor the minimum wage.

The equilibrium efficiency wage in this case is equal to

$$w_s = \frac{\beta}{1 - \beta} \frac{(1 - \beta)^{1-\theta}}{(1 - \beta e)^{1-\theta}} \bar{A} = \frac{\beta}{1 - \beta} \bar{A}; \quad (39)$$

where e is given by equation (38). An increase in the unemployment benefit rate or in the income tax rate increase the relative rent captured by skilled workers, measured by the coefficient β .

Solving the complete model using equations (32), (38) and (39), we can now analyze the effect of a modification of the unemployment benefit rate, \bar{A} .²³ Suppose that we operate along the “correct” portion of the taxation-unemployment benefit curve, implying that a drop in \bar{A} calls for a lower income tax rate. Applying (38) and (39) it follows that a drop in the unemployment benefit rate will reduce the efficiency coefficient as a result of both a lower opportunity wage and a lower income tax rate, and will increase the equilibrium level of effort. Applying the equilibrium conditions determining employment in the formal economy, it can be shown that output expands in the formal sector and contracts in the informal sector, at a rate proportional to the difference between the increase in effort and the fall in skilled workers’ wage.²⁴ While the mechanism through which these results obtain are qualitatively similar to those discussed in the first part of this section, there is an additional channel in the present case that reinforces the expansion of the formal sector: the resulting increase in equilibrium effort.

²³The effects of a change in the income tax rate are qualitatively similar to those discussed previously.

²⁴If the production function in the formal sector is given by equation (A1) in Appendix I, it can readily be shown that

$$\hat{Q}_F = \frac{\hat{e}}{1 - \beta} \epsilon_S(\hat{e}; \beta); \quad \hat{Q}_U = \frac{\hat{e}}{(1 - \beta)(1 - \beta e)} \epsilon_S(\hat{e}; \beta);$$

where a caret denotes a percentage change, and $0 < \epsilon_S; \epsilon_U < 1$ are relative shares defined in Appendix I.

5 Labor Mobility, Wages, and Unemployment

In the foregoing analysis, unskilled workers that were not hired in the formal sector were able to join immediately the labor force in the informal sector. By assuming that new entrants were successfully bidding wages down, we obviated the possibility that involuntary unemployment of that category of labor could emerge in equilibrium. However, assuming perfect mobility across sectors may lack realism, particularly in a short-run context. Workers typically incur a variety of costs (such as relocation expenses or congestion costs) that may prevent instant reallocation of the labor force. In this section we consider the case where movements of unskilled labor across sectors take place gradually, rather than instantaneously. We also maintain the assumptions made in section II regarding the effort decision of skilled workers and continue to take the composition of the labor force as given. In this extended framework, unemployment of both categories of labor may emerge in the short and in the long run.

As in the Harris-Todaro approach, we assume that potential migrants consider alternative opportunities available to them in both sectors and compare their expected utility in each location in order to choose the option that maximizes their expected net utility gains. Suppose that unskilled workers can only allocate time, not the level of effort.²⁵ Formally, let t_U denote total work time that an unskilled worker is required to commit (in a lump-sum fashion), and $t_m \leq t_U$ the maximum amount of leisure that he or she can possibly enjoy. Assuming as before that consumption and labor supply decisions are separable, and that the instantaneous utility of unskilled workers depends only on leisure and the wage received, we have

$$\ln u(w; t_U) = \alpha \ln w + a \ln(t_m - t_U); \quad a > 0; \quad (40)$$

where w is the real wage earned by the worker, which depends on the sector of employment.

Abstracting from migration and other relocation costs, the expected utility derived from working in the formal sector consists of two components. The first component is the utility derived from being employed in the formal sector at the legal minimum wage, weighted by the probability of being hired in that

²⁵This assumption is consistent with the observation made above that firms in the informal sector can readily monitor the level of effort provided by their workers. Without loss of generality, we normalize the constant level of effort to zero.

sector. This component is obtained by replacing w in (40) by w_U^a and multiplying the resulting expression—assuming that hiring is random—by the number of unskilled workers actually employed in the formal economy over the number of unskilled workers seeking jobs in the formal sector, $L_U^d = L_U^s$.²⁶ The second component is related to the possibility of being registered as unemployed in the formal sector and earning unemployment benefits—without allocating working time—which is taken to represent a fraction $0 < \alpha_U < 1$ of the minimum wage.²⁷ The expected utility in this case obtains by replacing w in (40) by $\alpha_U w_U^a$ and setting $t_U = 0$, and multiplying the resulting expression by the proportion of unemployed unskilled workers in the total pool of unskilled workers seeking jobs in the formal economy—that is, the probability of being unemployed in the formal sector. Thus, expected utility conditional on migrating to the formal sector $E(u_{j_F})$ is given by

$$E(u_{j_F}) = \left[\alpha_U \ln w_U^a + a \ln(t_m - t_U) \right] \left(\frac{L_U^d}{L_U^s} \right) + \left(\alpha_U \ln \alpha_U w_U^a + a \ln t_m \right) \left(\frac{L_U^s - L_U^d}{L_U^s} \right);$$

By contrast, expected utility derived from working in the informal sector is obtained simply by replacing w in equation (40) by the informal sector wage w_I , because the probability of being employed there is unity:

$$E(u_{j_I}) = \alpha_U \ln w_I + a \ln(t_m - t_U);$$

The evolution over time of the unskilled labor force in the formal sector is thus given by

$$\dot{L}_U^s = -\lambda [E(u_{j_F}) - E(u_{j_I})]; \quad \lambda > 0;$$

where λ denotes the speed of adjustment. Straightforward manipulations of the above equations yield

$$\dot{L}_U^s = -\lambda \left[\alpha_U \ln \left(\frac{w_U^a}{w_I} \right) + \hat{A}_{UF} \left(\alpha_U \ln \alpha_U + a \ln \left(\frac{t_m}{t_m - t_U} \right) \right) \right]; \quad (41)$$

²⁶ The absence of a forward-looking component in wage expectations formed by unskilled workers may be justified by the existence of large costs associated with search, and by the lack of sophistication of the unskilled labor force.

²⁷ Note that the reason why the choice between being employed or unemployed in the formal sector is not trivial is because unskilled workers must supply labor in a lump-sum fashion. Put differently, t_U is not a decision variable.

where $\hat{A}_{UF} = (L_U^s - L_U^d) / L_U^s$ denotes the unemployment rate of unskilled workers in the formal sector. In the long run, with $L_U^s = 0$, equation (41) yields

$$\hat{A}_{UF} = \frac{\ln(\frac{w_U^a}{w_U^i})}{a \ln[(\frac{t_m}{t_U}) = \frac{t_m}{t_U}] + \ln(\frac{w_U^i}{w_U^a})} = \hat{A}_{UF} (\frac{w_U^a}{w_U^i}; \frac{t_m}{t_U}); \quad (42)$$

which indicates that an increase in the unemployment benefit rate or the minimum wage raises the unemployment rate of unskilled workers in the formal sector. By contrast, an increase in the informal sector wage lowers the unemployment rate. This is because it reduces the efficiency wage paid to skilled workers, raises labor demand and output in the formal sector and thus employment of unskilled labor.

To obtain the overall unemployment rate for unskilled workers, note first that the distribution of the unskilled labor force is given by

$$L_U^s = L_U^d + L_U^d + (L_U^s - L_U^d);$$

which, given the definition of \hat{A}_F , is also equal to

$$L_U^s = L_U^d + L_U^d (1 - \hat{A}_{UF});$$

The overall unemployment rate of unskilled workers, defined as $\hat{A}_U = (L_U^s - L_U^d - L_U^d) / L_U^s$, is thus given by

$$\hat{A}_U = \frac{\hat{A}_{UF}}{1 - \hat{A}_{UF}} \left(\frac{L_U^d}{L_U^s} \right);$$

so that in the steady state

$$\hat{A}_U = \hat{A}_U (\frac{w_U^a}{w_U^i}; \frac{t_m}{t_U}); \quad (43)$$

Equation (43) indicates that in the steady state, an increase in the minimum wage has an ambiguous effect on the overall unemployment rate of unskilled workers. A rise in the informal sector wage (induced, for instance, by an increase in government spending on goods produced in the informal sector, g_I) reduces overall unemployment of unskilled labor in the long run.

The aggregate unemployment rate, \hat{A} , is given by

$$\hat{A} = \frac{L_S^s - L_S^d}{L^s} + \frac{L_U^s - L_U^d}{L^s};$$

or equivalently:

$$\hat{A} = \left(\frac{L_S^s}{L^s} i + \frac{L_U^d}{L^s} \right) \hat{A}_S + \hat{A}_U (1 - i - \hat{A}_S);$$

where $0 < \hat{A}_S < 1$ denotes the constant proportion of skilled workers in the labor force.

Given the dynamic equation (41), the extended framework described above can also be used to examine the short-run effects of fiscal and labor market policies on unemployment. By rewriting appropriately the government budget constraint (23)²⁸ and condensing the model yields now a differential equation system in three variables: the marginal utility of wealth, the stock of traded bonds, and the size of the unskilled labor force in the formal sector. Although we omit mathematical details here, it is intuitively clear that the impact effect of a change in the fiscal and labor market policy instruments discussed in previous sections will not alter the qualitative features highlighted before.²⁹

An important implication of the foregoing analysis, then, is that there may be no close relationship in the short run between changes in output and the unemployment rate—that is, no stable Okun’s law—as a result of spillover effects between the formal and informal segments of the urban labor market. In periods of adverse macroeconomic shocks (resulting, for instance, from cuts in government expenditure), skilled and unskilled workers laid off in the formal sector may seek employment in the informal sector, exerting downward pressure on wages there. Although the wage efficiency effect is likely to dampen the initial reduction in the work force of the formal sector, the sectoral reallocation of labor—which may be particularly marked in the absence of unemployment benefits in the formal sector and non-prohibitive relocation costs—may lead to large shifts in the composition of employment, with little effect on the aggregate unemployment rate. To the extent that

²⁸For instance, if government transfers consist of unemployment benefits paid only to unskilled workers in the formal sector, and if skilled workers continue to be subject to a tax on wages at the rate τ , the government budget constraint (23) would become

$$\dot{z} + \tau \left(\frac{L_U^d}{L^s} i + \frac{L_U^s}{L^s} \right) (L_U^s - L_U^d) + z^{1-\alpha} g_1 = 0;$$

²⁹This results, of course, from the fact that the proportion of the unskilled labor force seeking employment in the formal sector cannot change on impact. The transitional dynamics will in any case differ, as shown by Agénor and Santaella (1996) in a somewhat similar context.

labor productivity is lower in the informal sector, negative shocks to output will translate into a fall in average productivity instead of a rise in open unemployment.

The available evidence suggests indeed that spillover effects of the type described above may have played a significant role in the behavior of labor markets in developing countries during the 1980s.³⁰ The evidence examined by Agénor (1996), Horton et al. (1994), Riveros (1990) and Turnham (1993) suggests the occurrence of large shifts in the composition of employment from the formal to the informal sector in several countries in Latin America, as well as in several other nations of Africa and Asia, during the recessionary years of the 1980s. The evidence examined by Horton et al. (1994), Riveros (1990) and Turnham (1993) also suggests the occurrence of large shifts in the composition of employment from the formal to the informal sector in several countries in Latin America, as well as in several other nations of Africa and Asia, during the recessionary years of the 1980s.³¹

6 Summary and conclusions

The purpose of this paper has been to examine the implications of fiscal and labor market policies on output, wages and unemployment in a general equilibrium model of a small open developing economy with a large informal sector, a heterogeneous work force, and segmented labor markets. The production structure that we considered assumes that while production in the formal sector consists of traded goods and uses skilled and unskilled labor, output in the informal sector consists of nontraded goods produced using only unskilled labor. Firms in the formal sector were assumed to set the

³⁰The data, however, must be interpreted with care. Published measures of open unemployment mostly include only workers looking for jobs in the formal sector, but not underemployed workers in the informal and rural sectors. The effective degree of labor market slack may thus be understated.

³¹Perceived constraints on the level of employment in the formal sector may also discourage job seeking and lead some workers to simply drop out (at least temporarily) of the labor force, following adverse movements in output. Conversely, positive output shocks may lead to large inflows into the labor force. This “discouraged worker” effect, which is not captured in our framework, may also play a role in explaining the low correlation between output and the unemployment rate in developing countries. In addition, firms can dampen the effect of output shocks on employment by varying hours of work (through overtime), rather than through adjustment in the workforce.

wage rate for skilled labor so as to minimize labor costs per efficiency unit. Skilled workers' effort was shown to depend positively on their wage relative to the wage paid in the informal sector. Unskilled workers employed in the formal sector were assumed to earn a legally-fixed minimum wage, while wages of unskilled workers hired in the informal sector were taken to be flexible. In equilibrium, as a result of efficiency considerations, a noncompetitive wage differential emerges across skill categories. The efficiency wage earned by skilled workers, however, does not depend directly on the minimum wage.

Under the assumption of perfect labor mobility across sectors, we showed that a permanent, unanticipated reduction in government spending on non-traded goods leads in the long run to a depreciation of the real exchange rate, a fall in the informal sector wage, an increase in the production of traded goods, and a lower stock of net foreign assets held by the private sector. A permanent, unanticipated reduction in the minimum wage for unskilled workers was also shown to increase output and the demand for labor in the formal sector. Hence, in a two-sector economy in which the minimum wage is enforced only in the formal sector and wages in one segment of the labor market are competitively determined, efficiency wage considerations do not alter the standard neoclassical presumption: a reduction in the minimum wage improves competitiveness, and expands the formal sector at the expense of the informal sector.

The basic framework was subsequently extended to introduce direct income taxation and unemployment benefits for skilled workers in the formal sector. Assuming first that the unemployment benefit scheme consisted of paying a constant real wage to the unemployed, we showed that the economy faces a tradeoff between unemployment compensation and the income tax rate. If the economy operates on the "correct" portion of the taxation-unemployment benefit curve, a reduction in the level of unemployment compensation will raise the level of employment of skilled workers—thus leading to an expansion of the relative size of the formal sector. If, alternatively, the unemployment benefit scheme is assumed to link the level of compensation to the minimum wage for unskilled workers and the after-tax wage for skilled workers, a reduction in the unemployment benefit rate is also likely to lead to an expansion of output, effort and employment in the formal sector—at a rate proportional to the difference between the increase in effort and the fall in the premium associated with skilled workers' wage.

Finally, we considered the case in which unskilled workers face a decision to migrate from the informal sector to the formal sector. We derived the

incentive structure on the basis of which workers form their decision, along the lines suggested by Harris and Todaro (1970). By focusing the analysis on the long run, we showed that the overall unemployment rate of unskilled workers varies inversely with the informal sector wage, but that a change in the minimum wage for unskilled labor in the formal sector has an ambiguous effect. An important prediction of the model, the absence of a stable relation between changes in output and the open unemployment rate in the short run, appears to be consistent with the available evidence for developing countries.

The analytical framework developed here can be further extended in a variety of directions. One area of investigation would be to consider a situation where there exist technological input-output links between the formal and the informal sectors. For instance, the formal sector may be assumed to produce an intermediate good that is used in the production process for informal sector goods. Complementarity effects of this type may alter substantially the effect of macroeconomic shocks on output and the allocation of labor across sectors. Another possibility would be to examine the implications of alternatives to the Harris-Todaro intersectoral migration mechanism, perhaps by introducing the kind of heterogeneities discussed by Lindbeck and Snower (1991). It may also be useful to explore alternative mechanisms that may account for movements over time across skill categories, thus explaining endogenously changes in the composition of the labor force. Skill improvements take place through a variety of institutional forms, such as apprenticeship programs, on-the-job training, and internal labor markets. At the same time, training may impose a cost on firms and thus affect the sensitivity of the demand for labor with respect to changes in current wages. A final issue of importance would be to explain why government impose minimum wage laws in the first place—a phenomenon that creates, in our model, market segmentation for unskilled labor. A political economy approach may provide the critical elements necessary to account for the incentives to restrict wage flexibility.³² A sensible point of departure might be the recognition that workers in the formal sector may be better organized (through pressure groups, for instance) than informal sector workers, and may thus have a greater ability to force incumbent policymakers to legislate in their favor.

³²A different approach is adopted by Drazen (1986), who argues that minimum wage legislation may be welfare-improving (relative to the competitive equilibrium) in a model where information about worker quality is imperfect and labor quality rises with increases in the average market wage, as in urban labor markets where entrants are migrants from rural areas.

Although these extensions may prove valuable in their own right, they are unlikely to alter some of the key results of this paper. In particular, worker heterogeneity and labor market segmentation (induced by institutional constraints and firms' optimizing behavior) are essential elements in explaining the functioning of urban labor markets in developing countries, and play a key role in the transmission process of macroeconomic and structural policy shocks on output and employment. Policymakers may face a tradeoff between unemployment compensation and income taxation. Results of this type have important implications for the design of macroeconomic reform programs.

Appendix I

The purpose of this Appendix is to examine under what conditions it is possible to sign unambiguously the effect of the minimum wage on the supply of traded goods in the formal sector, and the effect of changes in the real exchange rate on output of the informal sector. To that effect, we assume that output in the formal sector is produced with a Cobb-Douglas technology in capital and a composite labor input, which takes the form of a CES function in skilled and unskilled labor. Assuming that the capital stock is fixed and normalized to unity yields:

$$Q_F = [(eL_S)^\sigma + L_U^\sigma]^{1/\sigma}; \quad \sigma > 1; \quad 0 < \sigma < 1; \quad (A1)$$

where σ measures the share of labor in production and σ a coefficient related to the elasticity of substitution between skilled and unskilled labor, which is equal to $1/(1 - \sigma)$.

Maximizing profits in the formal sector yields the following first-order conditions for the employment of skilled and unskilled labor:³³

$$(L_U + eL_S)^{\sigma-1} = e!_U^{\sigma-1}!_S; \quad (A2)$$

$$\sigma L_U^{\sigma-1} [(eL_S)^\sigma + L_U^\sigma]^{1-\sigma} = !_U^{\sigma-1}; \quad (A3)$$

where the result shown in (A2) uses equation (7) in the text. $e^{-\sigma} = (1 + \sigma)$ denotes the optimal level of export, which depends only on the parameter σ .

In percentage change form, equations (A2) and (A3) yield

$$(\sigma - 1)\hat{L}_U + (\sigma - 1)(\sigma - 1)\hat{L}_S + (\sigma - 1)\hat{L}_U = \sigma!_U^{\sigma-1};$$

$$(\sigma - 1)(\hat{L}_U - \hat{L}_S) = \sigma!_U^{\sigma-1} - \sigma!_S;$$

where $0 < \sigma_S; \sigma_U < 1$ are defined by

$$\sigma_S = \frac{eL_S^\sigma}{eL_S^\sigma + L_U^\sigma}; \quad \sigma_U = 1 - \sigma_S;$$

Solving the above equations yields

$$\hat{L}_S = [(\sigma - 1)\sigma_U \sigma_S!_U^{\sigma-1} - (\sigma - 1)\sigma_U \sigma_S!_S] / (\sigma - 1)(1 - \sigma_U); \quad (A4)$$

³³To simplify notations, the superscript 'd' used in the text to indicate labor demand is dropped in what follows.

$$\hat{L}_U = [(\sigma - 1) \alpha \beta \gamma (1 - \alpha) \beta \gamma \alpha] = (1 - \alpha)(1 - \sigma): \quad (A5)$$

Given the definitions given above, we have

$$0 < 1 - \sigma < \alpha < 1; \quad 0 < 1 - \alpha < \beta \gamma < 1:$$

The first result implies that $\hat{L}_S = \beta \gamma < 0$; the second implies that $\hat{L}_U = \alpha < 0$. A sufficient condition for both $\hat{L}_S = \beta \gamma$ and $\hat{L}_U = \alpha$ to be negative is that $\sigma < \alpha$, or that the elasticity of substitution between labor categories be less than $1 - \alpha$, as indicated in the text.

From equation (A1), $\hat{Q}_F = \sigma (\alpha \hat{L}_S + \beta \gamma \hat{L}_U)$. Using (A4) and (A5) yields

$$\hat{Q}_F = \sigma \frac{\alpha \beta \gamma}{1 - \alpha} (\alpha \beta \gamma + \beta \gamma \alpha): \quad (A6)$$

The production function in the informal sector is given by

$$Q_I = L_I^\gamma; \quad 0 < \gamma < 1;$$

so that, using equation (11) in the text:

$$\hat{L}_I = \gamma (\beta \gamma + \alpha) = (1 - \gamma): \quad (A7)$$

Because there is no unemployment, the aggregate labor market constraint ($L^S + L_S + L_U = L_I$, see equation (14)) can be written as

$$n_F (n_{FS} \hat{L}_S + n_{FU} \hat{L}_U) + n_I \hat{L}_I = 0; \quad (A8)$$

where $n_F = (L_S + L_U) / L^S$ measures the proportion of the total labor force employed in the formal sector, and $n_I = 1 - n_F$. The coefficient $n_{FS} = L_S / (L_S + L_U)$ measures the proportion of skilled workers in total employment in the formal sector, and $n_{FU} = 1 - n_{FS}$.

Substituting equations (A4), (A5), and (A7) in (A8) yields

$$\begin{aligned} & \sigma (1 - \gamma) \alpha \beta \gamma (\beta \gamma + \alpha) n_I + \frac{n_F}{(1 - \alpha)(1 - \sigma)} \beta \gamma \alpha [\alpha \beta \gamma (\sigma - 1) \alpha \beta \gamma \alpha + n_{FS} (1 - \sigma)] \\ & + \alpha \beta \gamma \alpha [\beta \gamma \alpha (\sigma - 1) \alpha \beta \gamma \alpha + n_{FU} (1 - \sigma)] g = 0; \end{aligned} \quad (A9)$$

which, setting $\hat{z} = 0$, yields

$$\frac{\hat{w}_I}{\hat{w}_U^\pi} = \frac{n_F[\lambda_U(\theta + \mu) + n_{FU}(1 - \theta)]}{(1 - \lambda_U)\lambda_I + n_F[\lambda_S(\theta + \mu) + n_{FS}(1 - \theta)]}; \quad (\text{A10})$$

where $\lambda = (1 - \mu)(1 - \theta)$. Equation (A10) indicates that a sufficient (although not necessary) condition for an increase in the minimum wage to raise the informal sector wage is $\theta > \mu$, as indicated in equation (15) in the text.

From (A6), we have

$$\text{sg}\left(\frac{\partial Q_F}{\partial \hat{w}_U^\pi}\right) = \text{sg}[\lambda_U + \lambda_S\left(\frac{\hat{w}_I}{\hat{w}_U^\pi}\right)]; \quad (\text{A11})$$

Substituting Equation (A10) in (A11) yields

$$\text{sg}\left(\frac{\partial Q_F}{\partial \hat{w}_U^\pi}\right) = \text{sg}\left[\lambda_U + \frac{n_F\lambda_S[\lambda_U(\theta + \mu) + n_{FU}(1 - \theta)]}{(1 - \lambda_U)\lambda_I + n_F[\lambda_S(\theta + \mu) + n_{FS}(1 - \theta)]}\right]; \quad (\text{A12})$$

or, after some manipulations,

$$\text{sg}\left(\frac{\partial Q_F}{\partial \hat{w}_U^\pi}\right) = \text{sg}\left[\frac{n_I\lambda_U(1 - \mu)}{1 - \lambda_U} + n_F(\lambda_U - n_{FU})\right]; \quad (\text{A13})$$

The first term in brackets in equation (A13) is unambiguously positive, but the sign of $(\lambda_U - n_{FU})$ is not known a priori. Given the definitions provided earlier, we have

$$\lambda_U - n_{FU} = \frac{L_U''}{eL_S'' + L_U''} - \frac{L_U}{L_S + L_U}; \quad (\text{A14})$$

If $\mu = 0$ (Cobb-Douglas case, which implies a unit elasticity of substitution between labor categories), we have, using the wage-setting equation (7) in the text,

$$\text{sg}(\lambda_U - n_{FU}) = \text{sg}(L_S - L_U) = \text{sg}\left[\frac{1}{3} \frac{L_U^\pi}{L_I} - 1\right];$$

which is negative as long as $L_U^\pi < \frac{3}{4}L_I$, that is, as long as the minimum wage for unskilled labor in the formal sector is lower than the efficiency wage earned by skilled workers—a very plausible restriction in practice.

If $\sigma < 1$ (Leontief technology), we also have

$$\text{sg}(\partial n_{FU} / \partial \tau) = \text{sg}(L_S - L_U) = \text{sg}(1 - \epsilon) = \text{sg} \left(1 - \frac{\sigma}{1 + \sigma} \right) > 0;$$

Thus, in the two particular cases considered above, the sign of the partial effect of an increase in the minimum wage on output in the formal sector differs.³⁴ We can also derive, however, a general condition for signing this effect when $1 > \sigma > 1$, that is, when the substitutability between skilled and unskilled workers is not too large. Using equation (A14) yields

$$\text{sg}(\partial n_{FU} / \partial \tau) = \text{sg}[L_S L_U^{-\sigma} - \epsilon L_S^{-\sigma} L_U] = \text{sg} \left(\frac{L_S}{L_U} \right)^{1-\sigma} - \epsilon^{\sigma};$$

which, using (A2), yields

$$\text{sg}(\partial n_{FU} / \partial \tau) = \text{sg} \left(\frac{L_U}{L_S} \right)^{\sigma} - \epsilon^{\sigma} = \text{sg} \left(\frac{L_U}{L_S} \right)^{\sigma} - 1;$$

which is negative, as long as the minimum wage is lower than the efficiency wage.

Regardless of the value taken by σ , as can be derived from equation (A12), a sufficient condition for $\text{sg}(\partial Q_F / \partial \tau) < 0$ is that n_I be close to unity (so that n_F is close to zero). Equivalently, the share of the informal sector must be relatively large.

Consider now the effect of a real exchange rate depreciation on output of the informal sector. From the production function defined earlier, we have

$$\text{sg} \left(\frac{\partial Q_I}{\partial Z} \right) = \text{sg}(1 + \tau_I \sigma):$$

Equation (A9) yields, with $\tau_U = 0$:

$$\tau_I = \frac{(1 - \sigma)^{-1} n_I}{(1 - \sigma)^{-1} n_I + n_F [L_S^{-\sigma} - \epsilon] + n_{FS} (1 - \sigma)};$$

so that

$$\text{sg} \left(\frac{\partial Q_I}{\partial Z} \right) = \text{sg} [L_S^{-\sigma} - \epsilon + n_{FS} (1 - \sigma)]; \quad (\text{A15})$$

The quantity in brackets on the right-hand side of equation (A15) is unambiguously positive if $\sigma > 1$. If this condition holds, then $\partial Q_I / \partial Z < 0$, as indicated in the text.

³⁴Note that if $\sigma < 1$ (so that labor categories are combined through a linear production process, and skilled and unskilled labor are perfectly substitutable inputs), firms in the formal sector would never hire skilled workers since in equilibrium $L_S > L_U$.

Figure 1
Productivity and Wages in the Formal Sector

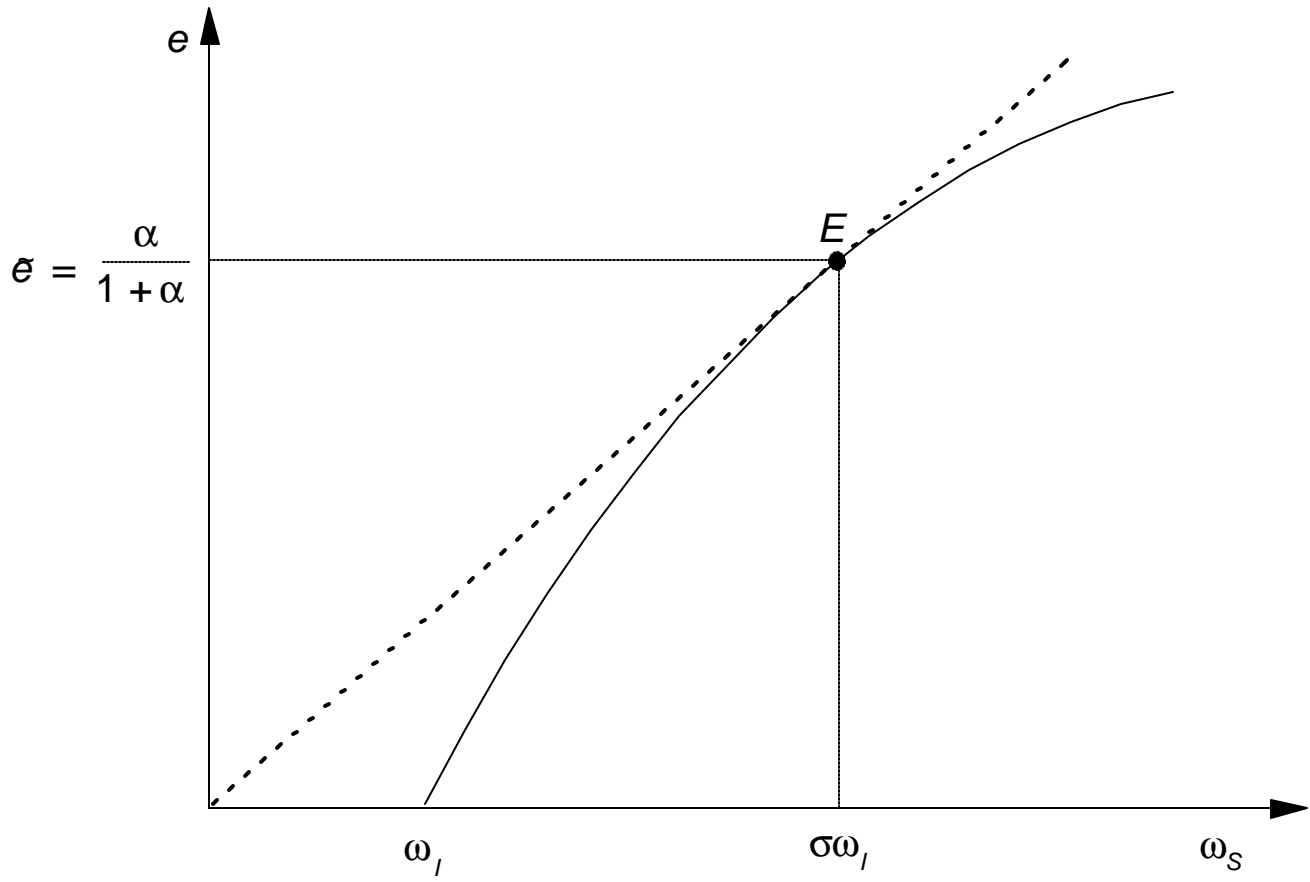


Figure 2

Steady-State Equilibrium

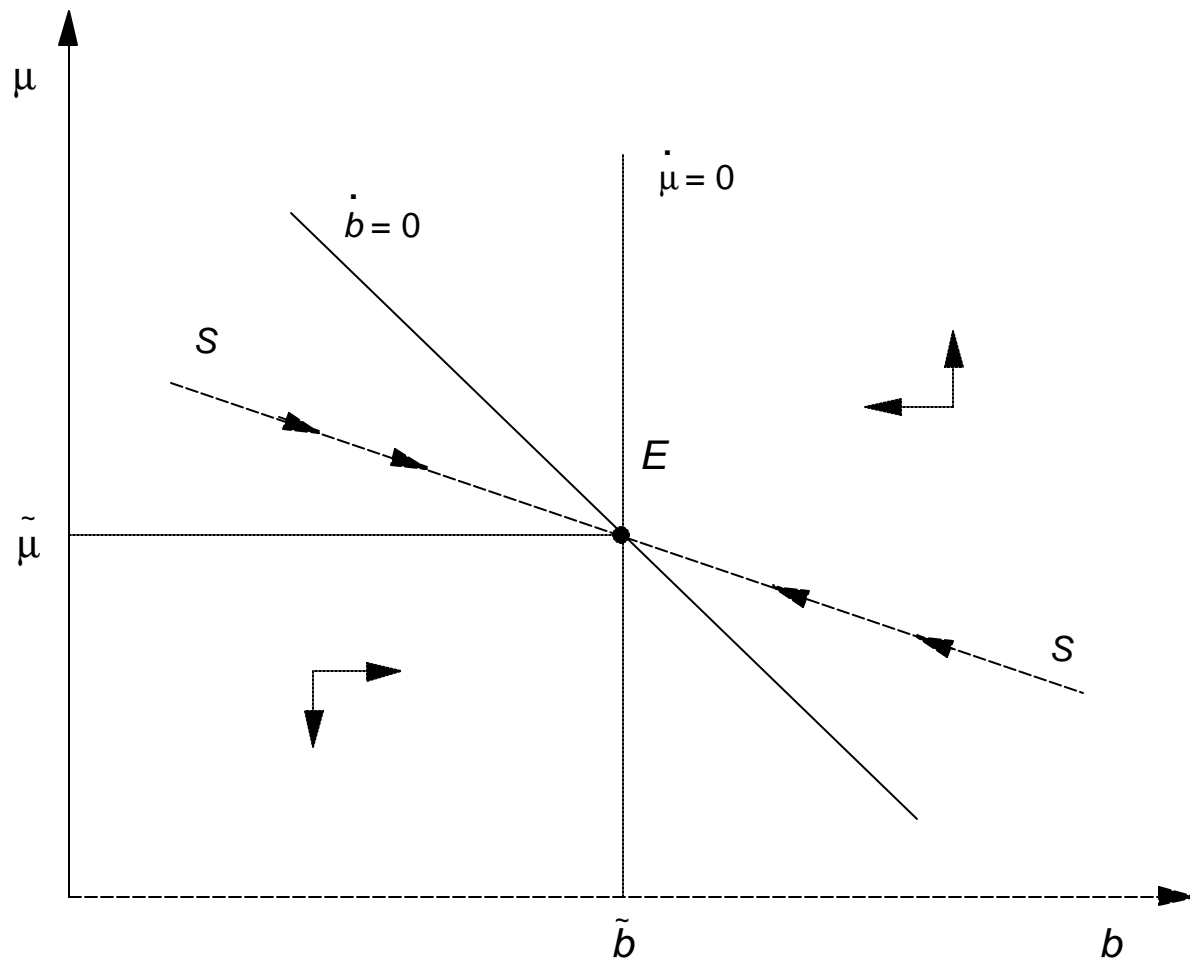


Figure 3

Reduction in Government Spending

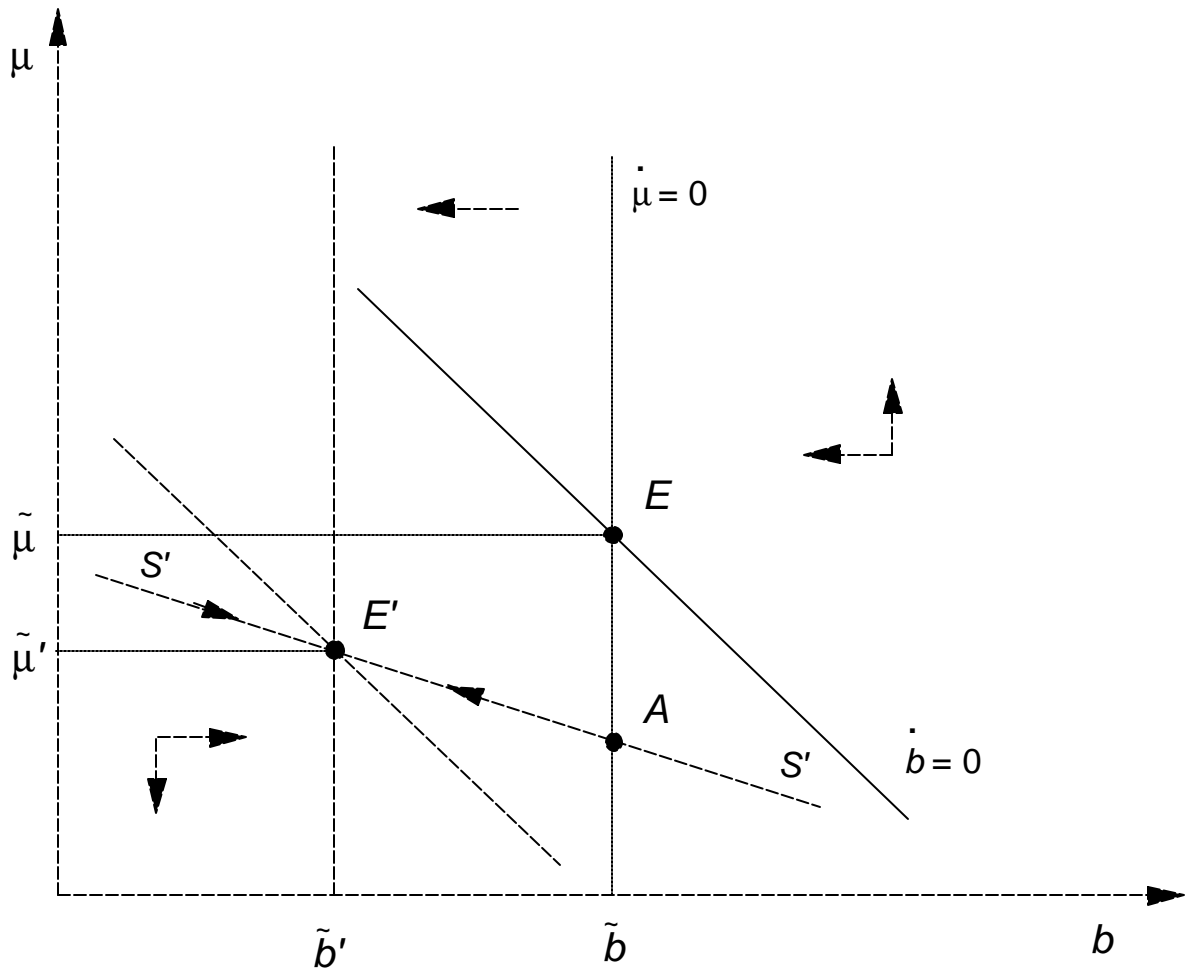


Figure 4

The Taxation-Unemployment Benefit Curve

