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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 developing economy with an informal sector and a heterogeneous work force. 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 improves competitiveness, and expands the formal sector. The effect of changes in unemployment benefits are also analyzed.

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1. Introduction

An increasing body of research in recent years has shown that labor force heterogeneity, wage-setting behavior and productivity considerations are important

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dimensions in understanding the behavior of the labor market in developing countries. 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. [1]

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 an informal sector and a segmented labor market. 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 2 develops the basic framework and examines the effect of changes in government expenditure and the minimum wage paid to unskilled workers on the composition of employment. Section 3 introduces income taxation and unemployment benefits, and analyzes how these modifications affect the determination of equilibrium wages, productivity, and employment. Section 4 summarizes the main implications of the paper.

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. [2] 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 fiat exists, but is enforced only in the formal sector. The wage rate for skilled labor in the formal sector is

[1] The implications of labor market segmentation in the absence of worker heterogeneity have been examined by Demekas (1990) and Agénor and Santaella (1998) in a short-term macroeconomic context, and by Edwards (1988) in the context of trade and structural reforms.

[2] Assuming 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.

assumed set on the basis of efficiency considerations (taking into account workers' opportunity earnings), leading to an above-equilibrium wage. [3] 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. [4] 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. [5]

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.

2.1. Production, effort, and the labor market

The production technology in the formal sector is given by [6]

$$Q_F = Q(eL_S, L_U), \tag{1}$$

where Q_F denotes output, e is the level of effort per skilled worker (which is bounded between 0 and unity by an appropriate choice of units), L_S is the employment of skilled workers and L_U is the 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

[3] There 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).

[4] Formal 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.

[5] The 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 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.

[6] For 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.

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 ω and the disutility of effort. All workers share the same instantaneous utility function $u(\omega, e)$ which, after appropriate normalizations, is defined as $\ln[\omega^{\gamma}(1-e)^{1-\gamma}]$, where $0<\gamma<1$. [7] Let π 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:

$$\gamma \ln \omega_S + (1-\gamma)\ln(1-e) \geq \gamma\pi \ln \omega_I + (1-\pi)\gamma \ln \omega_S, \tag{2}$$

where ω_S denotes the product wage of skilled workers in the formal sector, and ω_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 expected utility of a shirking worker as a weighted average of the wage earned if caught shirking and fired (with probability π), and if not caught (with probability $1-\pi$)—with a zero level of effort in both cases. [8]

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

$$e = 1 - \left(\frac{\omega_I}{\omega_S}\right)^{\alpha}, \quad \alpha \equiv \frac{\gamma\pi}{1-\gamma} > 0. \tag{3}$$

Eq. (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

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

[8] Our 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.

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. [9]

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 Eqs. (1) and (3) and assuming that firms incur no hiring or firing costs, the decision problem is thus

$$\max_{\omega_S, L_S, L_U} \prod_F = Q_F\left\{L_S\left[1-\left(\frac{\omega_I}{\omega_S}\right)^{\alpha}\right], L_U\right\} - \omega_S L_S - \omega_U^* L_U,$$

where ω_U^* denotes the legal minimum wage measured in terms of traded goods for unskilled workers, which is assumed binding in the formal sector. The first-order conditions for this optimization problem are:

$$\left(\frac{\partial Q_F}{\partial(eL_S)}\right)\left[1-\left(\frac{\omega_I}{\omega_S}\right)^{\alpha}\right] = \omega_S, \tag{4}$$

$$\left(\frac{\partial Q_F}{\partial(eL_S)}\right)\left(\frac{\omega_I}{\omega_S}\right)^{\alpha} = \alpha^{-1}\omega_S, \tag{5}$$

$$\partial Q_F/\partial L_U = \omega_U^*. \tag{6}$$

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

$$\omega_S = \sigma\omega_I,\ \sigma \equiv (1+\alpha)^{1/\alpha} > 1, \tag{7}$$

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. [10]

A graphical determination of the efficiency wage is shown in Fig. 1. [11] 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

[9] A 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.

[10] Eqs. (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).

[11] If 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 $(1-\gamma)\ln e_m$ would have appeared on the right-hand side of Eq. (2) and the level of effort that would be obtained when the wage ratio is unity would be e_m instead of 0.

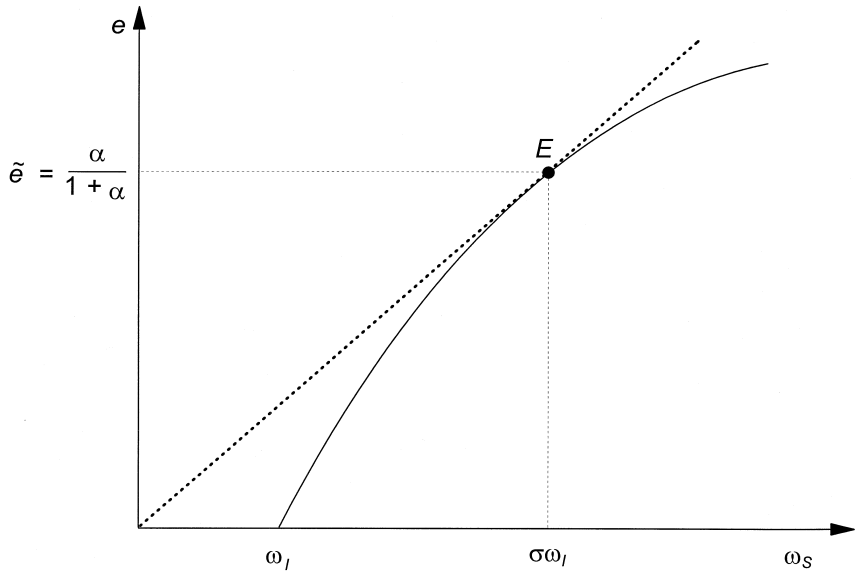

Fig. 1. Productivity and wages in the formal sector.

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. [12]

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

$$L_S^d = L_S^d(\bar{\omega}_I, \omega_U^*),\ L_U^d = L_U^d\left(\overset{?}{\omega}_I, \bar{\omega}_U^*\right). \tag{8}$$

An increase in the informal sector 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

[12] To 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.

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 Eqs. (7) and (8) in Eq. (1) yields

$$Q_F^s = Q_F^s(\bar{\omega}_I, \bar{\omega}_U^*), \tag{9}$$

which indicates that, given the condition discussed above, the partial equilibrium effect of an increase in either the minimum wage for unskilled workers or the informal sector wage 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

$$Q_I = Q_I(L_I),\ Q_I' > 0,\ Q_I'' < 0, \tag{10}$$

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

$$\Pi_I = z^{-1} Q_I(L_I) - \omega_I L_I,$$

where L_I denotes employment of unskilled workers in the informal sector and z is 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, $\omega_I = z^{-1} Q_I'$, from which labor demand can be derived as

$$L_I^d = Q_I'^{-1}(z\omega_I) = L_I^d(z\omega_I),\ L_I^{d\prime} < 0, \tag{11}$$

where $z\omega_I$ measures the product wage in the informal sector. Substituting this result in Eq. (10) implies

$$Q_I^s = Q_I^s(z\omega_I),\ Q_I^{s\prime} < 0. \tag{12}$$

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

$$Q = Q_F^s + z^{-1} Q_I^s. \tag{13}$$

Let L^s denote total labor supply in the economy, and L_S^s, the 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

$$L_S^s - L_S^d(\omega_I, \omega_U^*) + L_U^s - L_U^d(\omega_I, \omega_U^*) = L_I^d(z\omega_I), \tag{14}$$

which can be solved for the equilibrium value of ω_I:

$$\omega_I = \kappa(\bar{z}, \bar{\omega}_U^*). \tag{15}$$

Eq. (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 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 by [13]

$$\int_0^\infty \ln\left(c_I^\delta c_F^{1-\delta}\right) e^{-\rho t} \mathrm{d}t, \quad \rho > 0, 0 < \delta < 1, \tag{16}$$

where ρ 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

$$\dot{b} = i* b + Q - z^{-1} c_I - c_F - \tau, \tag{17}$$

where τ denotes real lump-sum taxes (measured in terms of traded goods), and $i*$ is 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: [14]

$$i* = i*\left(\bar{b}, \tilde{Q}_I^s / \tilde{z}\tilde{Q}_F^s\right), \tag{18}$$

where $\tilde{z}$, $\tilde{Q}_I^s$ and $\tilde{Q}_F^s$ denote the long-run values of z, Q_I^s and Q_F^s. [15]

[13] For clarity, only the consumption part of households' utility is explicitly specified in Eq. (16), since consumption and effort 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.

[14] See 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.

[15] For simplicity, we assume $i*(\cdot,\cdot)$ to be continuously differentiable. More generally, the function could have a 'kink' at a critical value of the stock of bonds. We also impose $i*(0,\cdot) = \rho$, which fixes the real interest rate, for a zero level of net indebtedness, to the rate of time preference.

Households treat Q, z, $i*$ and τ as given and maximize Eq. (16) subject to Eq. (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:

$$(1-\delta)/c_F = \mu, \tag{19}$$

$$c_I = \delta z c_F/(1-\delta), \tag{20}$$

$$\dot{\mu} = (\rho - i*)\mu, \tag{21}$$

in addition to Eq. (17) and the transversality condition $\lim_{t\to\infty} be^{-\rho t} = 0$. μ, the costate variable associated with the asset accumulation equation, measures the shadow value of wealth.

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

$$Q_I^s(z\omega_I) = \frac{\delta z}{1-\delta} c_F(\mu) + g_I, \tag{22}$$

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:

$$\tau - g_F - z^{-1} g_I = 0. \tag{23}$$

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 Eq. (15) in Eq. (9) yields

$$Q_F^s = q_F^s\left(\overset{+}{z}, \omega_U^*\right). \tag{24}$$

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 Eq. (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 Eq. (15) in the equilibrium condition of the nontraded goods market (Eq. (22)) yields

$$q_{\mathrm{I}}^{\mathrm{s}}\left(\overset{?}{z}, \omega_{\mathrm{U}}^{*}\right) = \frac{\delta z}{1-\delta} c_{\mathrm{F}}(\mu) + g_{\mathrm{I}}. \tag{25}$$

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 Eq. (14)), the same condition ensures that and 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 Eq. (25) yields the equilibrium solution for the real exchange rate:

$$z = z\left(\overset{+}{\mu}; \bar{g}_{\mathrm{I}}, \bar{\omega}_{\mathrm{U}}^{*}\right). \tag{26}$$

Substituting Eqs. (13), (22), (23) and (26) in Eq. (17) yields

$$\dot{b} = i*\left(b, \tilde{Q}_{\mathrm{I}}^{\mathrm{s}}/\tilde{z}\tilde{Q}_{\mathrm{F}}^{\mathrm{s}}\right) b + q_{\mathrm{F}}^{\mathrm{s}}\left[z(\mu; g_{\mathrm{I}}, \omega_{\mathrm{U}}^{*}), \omega_{\mathrm{U}}^{*}\right] - c_{\mathrm{F}}(\mu) - g_{\mathrm{F}}, \tag{27}$$

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

$$\dot{\mu}/\mu = \rho - i*\left(b, \tilde{Q}_{\mathrm{I}}^{\mathrm{s}}/\tilde{z}\tilde{Q}_{\mathrm{F}}^{\mathrm{s}}\right) \tag{28}$$

Eqs. (27) and (28) determine the behavior of foreign assets and the marginal utility of wealth over time. Given the solution for μ, Eq. (26) determines the equilibrium level of the real exchange rate.

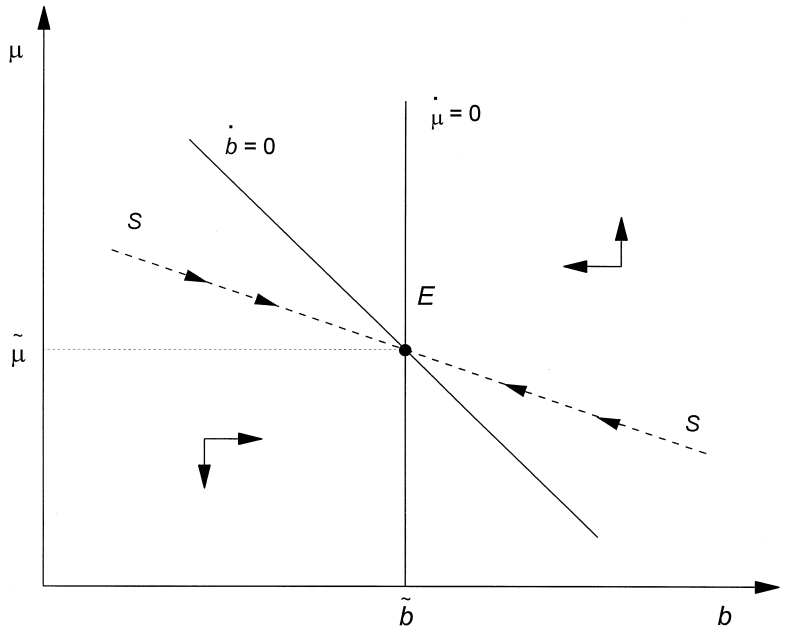

Fig. 2. Steady-state equilibrium.

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

$$\begin{bmatrix} \dot{\mu} \\ \dot{b} \end{bmatrix} = \begin{bmatrix} 0 & -\tilde{\mu}(\partial i*/\partial b) \\ (\partial q_F^s/\partial z)\, z_\mu - c'_F & i* + \tilde{b}(\partial i*/\partial b) \end{bmatrix} \begin{bmatrix} \mu - \tilde{\mu} \\ b - \tilde{b} \end{bmatrix}, \tag{29}$$

where $\tilde{\mu}$ and $\tilde{b}$ denote the steady-state solutions of the system. We will assume in what follows that $\mathrm{d}(i* b)/\mathrm{d}b > 0$, 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 Eq. (29) is locally saddlepoint stable. [16] The steady-state equilibrium is depicted in Fig. 2. Curves $[\dot{\mu} = 0]$ and $[\dot{b} = 0]$ give combinations of μ and b for which the marginal utility of wealth and

[16] Given our sign assumptions, the determinant of the matrix of coefficients in Eq. (29) is negative. Note that this condition holds irrespective of the value taken by $\mathrm{d}(i* b/\mathrm{d}b$.

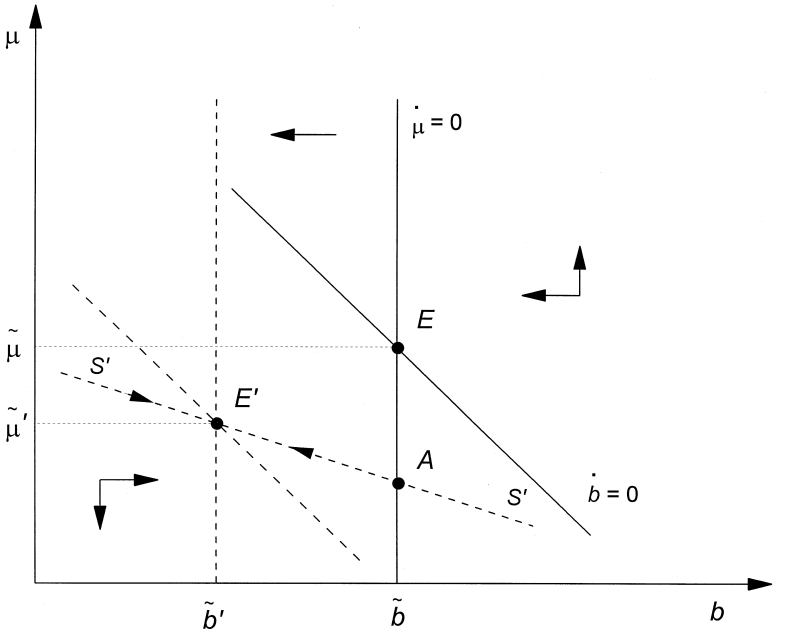

Fig. 3. Reduction in government spending.

the stock of bonds remain constant. The negatively sloped saddlepath *SS* leads to point *E*, the steady-state equilibrium. [17]

Consider a permanent, unanticipated reduction in government spending on nontraded goods. The dynamics of adjustment are illustrated in Fig. 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 utility of wealth, there is an incipient current account surplus, which induces a leftward shift in the $[\dot{b} = 0]$ 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 $[\dot{\mu} = 0]$ curve also leftward. The new long-run equilibrium is point E', with the associated saddlepath denoted $S'S'$. On impact, both the drop in

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

the interest rate facing the country and the drop in the relative price of nontraded 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 Eq. (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'. In the transition towards the new long-run equilibrium, the real exchange rate depreciates steadily, 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. [18] Hence, the presence of efficiency wages and segmented labor markets does 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 Fig. 3. The long-run reduction in the relative size of the informal sector improves the creditworthiness of the country, shifting the curve $[\dot{\mu} = 0]$ leftward. Similarly, the incipient excess supply of nontraded goods induces a real depreciation (that is, an increase in z), thereby shifting the $[\dot{b} = 0]$

[18] More 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.

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 affect 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.

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 now assume that unsuccessful applicants choose to remain unemployed, while receiving a government-financed unemployment benefit. [19] The unemployment insurance scheme is financed in part by a tax on wage income, levied at the rate $0 < \iota < 1$ 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 θ, takes the form of a flat real wage. As before, optimal effort is determined so that the expected utility derived from working without

[19] 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.

shirking must be equal in equilibrium to the expected utility derived if caught shirking. Condition (2) becomes now

$$\gamma \ln\left[(1-\iota)\,\omega_S\right] + (1-\gamma)\ln(1-e) \geq \gamma\pi \ln\theta + (1-\pi)\,\gamma \ln\left[(1-\iota)\,\omega_S\right], \tag{30}$$

so that

$$e = 1 - \left\{ \frac{\theta}{(1-\iota)\,\omega_S} \right\}^{\alpha}, \tag{31}$$

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

$$\tau + \iota\omega_S L_S^d - \theta\left(L_S^s - L_S^d\right) - g_F - z^{-1} g_I = 0. \tag{32}$$

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

$$\omega_S = \sigma\theta/(1-\iota), \tag{33}$$

and that the supply function of the formal sector becomes

$$Q_F^s = Q_F^s\left\{ \frac{\sigma\theta}{1-\iota}, \omega_U^* \right\}, \tag{34}$$

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

$$L_U^s - L_U^d\left\{ \frac{\sigma\theta}{1-\iota}, \omega_U^* \right\} = L_I^d(z\omega_I), \tag{35}$$

which can be solved for ω_I.

Using the budget constraint (32), and Eqs. (34) and (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 $\iota - \theta$ space, which is displayed in Fig. 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 Fig. 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

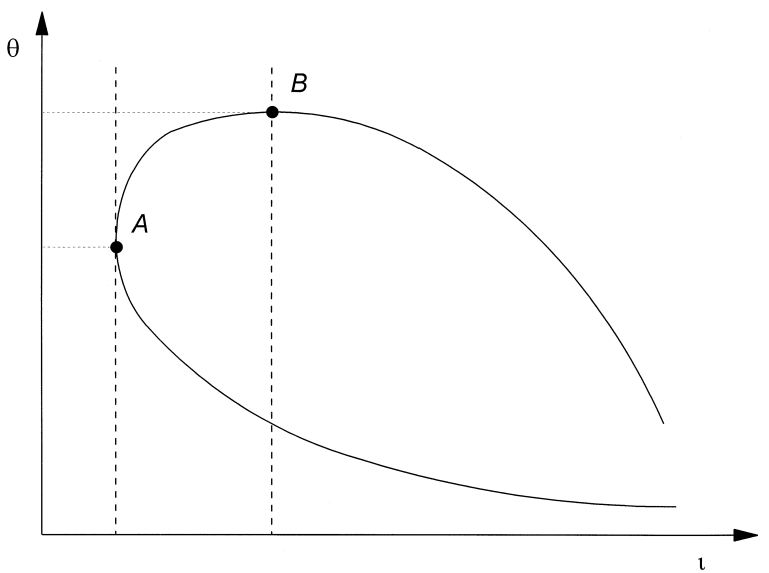

Fig. 4. The taxation–unemployment benefit curve.

skilled workers—as a result of the government budget constraint—thus reducing the producer real wage (see Eq. (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 economy. 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 Fig. 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:

$$\theta = \omega_U^* + \upsilon(1-\iota)\,\omega_S, \quad 0 \le \upsilon \le 1. \tag{36}$$

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

$$e = 1 - \left\{ \upsilon + \frac{\omega_U^*}{(1-\iota)\,\omega_S} \right\}^{\alpha}, \tag{37}$$

where the level of effort depends now not only on the rate of taxation, but also directly on the unemployment benefit rate υ, 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

$$(1-\tilde{e})^{1/\alpha}\left[\alpha(1-\tilde{e}) - \tilde{e}\right] - \alpha\upsilon(1-\tilde{e}) = 0,$$

where $\tilde{e}$ denotes the equilibrium level of effort. It can be shown that

$$\tilde{e} = \tilde{e}\left(\overset{+}{\upsilon}, \overset{+}{\alpha}\right), \tag{38}$$

which indicates that in equilibrium, effort depends negatively on the unemployment benefit rate and positively on the parameter α—and thus, from Eq. (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

$$\omega_S = \sigma\omega_U^*, \quad \sigma \equiv \frac{(1-\iota)^{-1}}{(1-\tilde{e})^{1/\alpha} - \upsilon} = \sigma\left(\overset{+}{\upsilon}, \overset{+}{\iota}\right), \tag{39}$$

where $\tilde{e}$ is given by Eq. (38). An increase in the unemployment benefit rate or in the income tax rate increases the relative rent captured by skilled workers, measured by the coefficient σ.

Solving the complete model using Eqs. (32), (38) and (39), we can now analyze the effect of a modification of the unemployment benefit rate, υ.

Suppose that we operate along the 'correct' portion of the taxation–unemployment benefit curve, implying that a drop in v calls for a lower income tax rate. Applying Eqs. (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 is shown in Appendix I 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. 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.

5. 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 production in the formal sector consists of traded goods and uses skilled and unskilled labor, while output in the informal sector consists of nontraded goods. Firms in the formal sector were assumed to set the 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 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.

We showed that a permanent, unanticipated reduction in government spending on nontraded 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, and the trade-off between these two policy instruments was discussed.

An important implication of our analysis 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 nonprohibitive relocation costs—may lead to large shifts in the composition of employment, with little effect on the aggregate unemployment rate. To the extent that 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. [20] The evidence examined by Riveros (1990), Turnham (1993), Horton et al. (1994), and Agénor (1996) 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. [21]

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[20] The 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.

[21] Perceived 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.

paper, which contains Appendices I and II, is available upon request. The views expressed here do not necessarily represent those of the Fund or the World Bank.

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