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Employment effects of stabilization policies

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Abstract

This paper studies the effects of a stabilization program based on a reduction in the devaluation rate in an optimizing model with capital controls, minimum wages for unskilled labor, an informal sector, and public production of intermediate inputs. Perfect mobility across sectors of the unskilled labor force prevents the emergence of unemployment for that category of labor, but skilled unemployment prevails in equilibrium. The analysis highlights the role of endogenous labor market segmentation in assessing the wage and employment effects of stabilization policies.

JEL classification: F41; J31; J64
Keywords: Employment; Stabilization policies; Devaluation rate

1. Introduction

It has long been recognized that wage flexibility and intersectoral labor mobility play an important role in the transmission of macroeconomic policy shocks. Downward rigidity in real wages, for instance, usually prevents a nominal exchange rate adjustment from translating into a change in relative prices, thereby hampering the reallocation of resources toward production of tradable goods. Similarly, a low degree of labor mobility across sectors may raise unemployment, and thus increase the transitional costs—or even the sustainability—of macroeconomic and structural reform programs.

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A variety of factors have led in recent years to renewed interest in the role of labor markets in the process of economic adjustment in developing countries.[1] First, growing recognition of the importance of the informal sector in generating employment in response to adverse short-run economic shocks in the formal economy has prompted several attempts at better understanding the interrelations between the formal and the informal sectors, most notably factors explaining labor reallocation.[2] Second, various studies have shown that real wages in developing countries appear to be considerably more flexible than generally assumed. During the low-growth years of the 1980s, for instance, they fell dramatically in many countries (Horton et al., 1994). Evidence of a high degree of wage flexibility has led many economists to question the adequacy of conventional views on the sources of unemployment. Third, attempts to stabilize during the 1980s led in many countries to fiscal restructuring—which in many cases involved constraining the growth in (or reducing the level of) public sector employment and maintaining wage increases below inflation. Because the public sector remains a major employer in the formal sector in many developing countries (it accounted, for instance, for 25% of employment in Tunisia and 40% in Jordan in the mid-1990s), changes in the government's employment and wage-setting policies tend to have significant effects on private sector wages and employment. Understanding how such effects are transmitted to the rest of the economy has become an issue of major importance. Finally, the increased incidence of poverty and wage dispersion during the past two decades has raised concerns about the social and distributional effects of adjustment programs in developing countries, and has led many researchers to focus on the role of labor market institutions and regulations.

This paper analyzes the effects of a stabilization program based on a reduction in the devaluation rate on the labor market and aggregate output. As discussed extensively by Agénor (2000) and Agénor and Montiel (1996), exchange rate based programs have been implemented by many developing countries (particularly in Latin America) in the past three decades in their attempt to stabilize from high inflation. Although there exists a large literature on the aggregate dynamics associated with these programs, there has been relatively little emphasis on the role of the labor market. The integration of the monetary and real sectors makes the model presented in this paper particularly suitable for the analysis of the labor market implications of financial and exchange rate policies in the short run. Specifically, the analysis is based on a framework that incorporates several features that are deemed important for developing countries: capital controls, a

[1] See Agénor (1996, 1999) and the World Bank (1995) for comprehensive accounts of the recent literature in that area.

[2] See notably Agénor and Aizenman (1999) and Agénor and Santaella (1998). Both papers provide an analysis of wage efficiency considerations in the context of an optimizing model with segmented labor markets.

large informal sector, public sector production and employment, a heterogeneous labor force, binding minimum wages and turnover costs in the formal sector, and wage and price flexibility in the informal economy.

Section 2 presents the analytical framework. Section 3 expresses the model in a compact dynamic form. Section 4 examines the short- and longer-run effects of a reduction in the devaluation rate. The analysis emphasizes the effects of these policy shocks on the composition of employment across sectors, relative wages, and unemployment. Section 5 summarizes the main results of the paper and discusses some possible extensions of the analysis.

2. The analytical framework

Consider a small open economy in which four categories of agents operate: firms, households, the government, and the central bank. The exchange rate is depreciated at a predetermined rate by the central bank. The economy consists of two major segments: the formal economy and the informal sector. In the formal economy, only one good is produced: an exportable good, whose output is entirely sold abroad.[3] Firms in the informal economy produce a nontradable good, which is used only for final domestic consumption. The capital stock in each production sector is fixed within the time frame of the analysis. The labor force (which is also constant) is heterogeneous and consists of skilled and unskilled workers. Production of the nontradable good requires only unskilled labor, whereas both labor categories are used as intermediate inputs to produce exportables.[4]

In the exportable sector, the real wage (measured in terms of the domestic price of exportables) earned by skilled workers is determined so as to minimize turnover costs (which include hiring, training, litigation, and firing costs), whereas unskilled workers earn a minimum wage fixed by the government. For a given level of wages, firms in the exportable sector determine the level of employment of both categories of labor so as to maximize profits. Unskilled workers can move freely and instantaneously between the formal and the informal sectors. The informal sector therefore absorbs all unskilled workers who are not hired in the formal sector. Wages in that sector adjust continuously to equilibrate supply and demand for labor. Prices are also flexible in the informal sector, and adjust to eliminate excess demand for nontradable goods.

[3] The absence of an import-competing sector can be rationalized the assumption that the efficiency losses induced by barriers to foreign trade—which are not explicitly modeled here—are so large that goods that are in principle importable have effectively become nontraded (Agénor and Aizenman, 1996).

[4] The assumption that the nontraded goods sector does not use skilled labor is consistent with the evidence on employment structure in the informal sector in many developing countries.

There is no unemployment benefit scheme in the economy. Unskilled workers' opportunity cost of effort (foregone leisure) is taken to be nil; those who are unable to find employment in the formal sector are thus always willing to move to the informal economy. By contrast, skilled workers who are not successful in applying for a job in the exportable sector always opt to remain unemployed, rather than take up employment in the informal sector. The assumption here is that the going wage in the informal economy, adjusted for the perceived net cost of working there—which depends on factors such as demotivation effects, inefficiencies associated with on-the-job search activities, loss of skills or social prestige, and the extent of the "safety net" provided by relatives—is always lower than the skilled workers' reservation wage. Thus, "quasi-voluntary" unemployment of skilled workers—a key feature of the labor market in developing countries, as discussed later—emerges in equilibrium.[5]

Households supply labor inelastically and consume, in addition to the nontradable good produced in the informal sector, an imperfectly substitutable imported good. They hold three categories of assets: domestic money (which bears no interest), foreign bonds, and domestic government bonds. Money and government bonds are held only domestically. Capital controls (which take the form of a tax on holdings of foreign assets) impede the mobility of capital across borders. Finally, the government consumes imported goods, receives transfers from the central bank, and pays interest on its domestic debt and levies (in addition to taxes on private foreign assets) lump-sum taxes on households.

2.1. Output in the formal economy

As stated above, only one exportable good is produced in the formal economy. The world price of exportables is exogenous and normalized to unity for simplicity. The domestic price of exportables is thus equal to the nominal exchange rate, E.

Let n_S and n_U denote employment levels of skilled and unskilled labor (measured in natural units). The representative producer's production function in the exportable sector is given by[6]

$$Y_E = V(n_S, n_U), \tag{1}$$

[5] Because there is no unemployment benefit scheme in the present framework, unemployed workers in the long run are implicitly assumed to either turn to a subsistence activity (home production) or to rely on relatives to cater for their basic needs.

[6] Except otherwise indicated, partial derivatives are denoted by corresponding subscripts, while the total derivative of a function of a single argument is denoted by a prime. A sign over a variable refers to the sign of the corresponding partial derivative, and $\dot{x} \equiv dx/dt$. Time subscripts are omitted for simplicity. A tilde over a variable is used to denote steady-state values.

where V is linear homogeneous in n_S and n_U with partial derivatives given by $V_{n_S}, V_{n_U} > 0$, $V_{n_S n_S}, V_{n_U n_U} < 0$, and $V_{n_S n_U} > 0$. Skilled and unskilled labor are thus taken to be Edgeworth complements in the production of value added.[7]

Let ω_S denote the real wage paid to skilled workers employed in the exportable sector and $\omega_U < \omega_S$ the real minimum wage earned by unskilled workers (both measured in terms of the price of exportables). In addition to normal costs associated with the use of labor inputs in the production process, firms incur a total cost of $\phi_S q^S n_S$ in hiring and training newly acquired skilled workers, with q^S denoting the quit rate and ϕ_S the cost incurred in recruiting and training each worker. Similarly, training costs for unskilled workers are given by $\phi_U q^U n_U$, where $\phi_U < \phi_S$. Following Stiglitz (1974), the quit rate for skilled workers is specified as depending negatively on the unemployment rate for that category of labor, u_S, as well as the ratio of ω_S to the reservation wage. By contrast, the quit rate for unskilled workers is specified as depending only on the ratio of the minimum wage ω_U to the reservation wage, because the assumption of perfect labor mobility across sectors rules out unemployment for that category of labor.

Unskilled workers' reservation wage is equal to the going wage in the informal sector wage, ω_I, whereas skilled workers' reservation wage, $\Omega_S > \omega_I$, is taken to be exogenous (as noted earlier, such workers never consider working in the informal sector as an option). Thus, the quit rates can be written as

$$q^S = q^S\left(\frac{\overline{\omega}_S}{\Omega_S}, \bar{u}_S\right), \quad q^U = q^U\left(\frac{\overline{\omega}_U}{\omega_I}\right), \tag{2}$$

where $u_S = 1 - n_S^d/n_S^s$, with n_S^s (n_S^d) denoting the supply (demand) of skilled labor. It is also assumed that $q^S_{\omega_S\omega_S}$, $q^U_{\omega_U\omega_U} < 0$.[8] If q^S become less responsive to wages at higher levels of unemployment, so that $q^S_{\omega_S}$ becomes less negative as the unemployment rate increases, it will also satisfy the condition $q^S_{\omega_S u_S} > 0$. Alternatively, if a higher unemployment rate results in a stronger effect of a given change in the wage ratio on the quit rate, $q^S_{\omega_S u_S} < 0$. The analysis below focuses on the latter case, which ensures that an increase in unemployment lowers the optimal wage.

Profits of the representative firm in the exportable sector are given by

$$Y_E - \left(\omega_S + \phi_S q^S\right) n_S - \left(\omega_U + \phi_U q^U\right) n_U.$$

[7] The assumption that an increase in the use of unskilled labor raises—as theory would suggest—the marginal productivity of skilled labor does not of course, preclude the possibility that skilled and unskilled labor are net (Hicks–Allen) substitutes. For some recent evidence on the substitutability between skilled and unskilled labor in the formal (manufacturing) sector in developing countries, see Cárdenas and Gutiérrez (1996), and Roberts and Skoufias (1997).

[8] These restrictions on the quit functions are necessary to ensure that the second-order conditions for profit maximization are satisfied.

Using Eqs. (1) and (2), profit maximization with respect to ω_S, n_S and n_U (with ω_U and ω_I given) yields

$$-\phi_S q^S_{\omega_S}\left(\frac{\omega_S}{\Omega_S}, u_S\right) = \Omega_S, \tag{3}$$

$$V_{n_S}(\cdot) = \omega_S + \phi_S q^S\left(\frac{\omega_S}{\Omega_S}, u_S\right), \tag{4}$$

$$V_{n_U}(\cdot) = \omega_U + \phi_U q^U\left(\frac{\omega_U}{\omega_I}\right). \tag{5}$$

Eq. (3) is the optimal wage setting condition. It can be rewritten as $\phi_S q^S_{\omega_S}/\Omega_S = -1$, which is the familiar condition indicating that minimizing production costs associated with the use of skilled labor is achieved when a rise in skilled workers' wage increases direct labor costs by as much as it reduces turnover costs.

Given the assumptions stated above regarding the sign of $q^S_{\omega_S\omega_S}$ and $q^S_{\omega_S u_S}$, and given the definition of u_S, Eq. (3) implies that the equilibrium skilled workers' wage can be written as

$$\omega_S = \omega_S(\bar{u}_S) = \omega_S\overset{+}{(}n^d_S), \tag{6}$$

which shows that an increase in open unemployment (or a reduction in labor demand), by reducing the quit rate, lowers the optimal wage paid to skilled workers.[9]

From Eqs. (4) and (5), and with the second-order conditions for profit maximization imposing $V_{n_S n_S}V_{n_U n_U} - V^2_{n_S n_U} > 0$, the demand functions for labor can be derived as

$$n^d_S = n^d_S\left(\bar{\omega}_S, \bar{\omega}_I; \overset{?}{\omega}_U\right), \quad n^d_U = n^d_U\left(\bar{\omega}_S, \bar{\omega}_I; \overset{?}{\omega}_U\right), \tag{7}$$

which, using Eq. (6), can be rearranged to give

$$n^d_S = n^d_S\left(\bar{\omega}_I; \overset{?}{\omega}_U\right), \quad n^d_U = n^d_U\left(\bar{\omega}_I; \overset{?}{\omega}_U\right). \tag{8}$$

Eq. (8) indicates that an increase in the informal sector wage, by increasing the quit rate of unskilled workers (and thus turnover costs) in the exportable sector, lowers the demand for that category of labor. As a result of gross complementarity between labor categories, the demand for skilled labor falls also. By contrast, the effect of changes in the minimum wage on labor demand are in general ambiguous. On the one hand, an increase in the minimum wage raises labor costs directly

[9] Hoddinot (1996), for instance, found evidence of a negative relationship—albeit at the aggregate level—between wage and unemployment levels in Africa.

and reduces demand for both categories of labor. On the other, the induced reduction in turnover costs associated with the reduction in the quit rate of unskilled workers tends to increase the demand for that category of labor, as well as the demand for skilled labor. If unit turnover costs ϕ_U or the sensitivity of the quit rate to wages $q^U_{\omega_U/\omega_I}$ are not too large, the direct effect will dominate and a rise in ω_U will reduce demand for both categories of labor.

Substituting the solution for n^d_S in Eq. (6) yields

$$\omega_S = \omega_S\left(\overline{\omega}_I; \overset{?}{\omega}_U\right), \tag{9}$$

which leads to the following proposition.

Proposition 1. *The optimal wage for skilled workers, ω_S, is independent of the informal sector wage if (a) there are no turnover costs on unskilled labor ($\phi_U = 0$); (b) the quit rate for unskilled labor does not depend on relative wages ($q^U_{\omega_U/\omega_I} = 0$); or (c) the quit rate for skilled workers is independent of the level of unemployment ($q^S_{u_S} = 0$). In the latter case, ω_S is also independent of the minimum wage.*

Intuitively, a rise in the informal sector wage, by increasing the quit rate for unskilled labor in the exportable sector, lowers the demand for that category of labor and reduces (as a result of gross complementarity of production factors) the demand for skilled labor. The skilled unemployment rate rises as a result, leading to a reduction in the optimal wage for skilled workers. If the unit turnover cost associated with unskilled labor is zero ($\phi_U = 0$), or equivalently if the quit rate for that category of labor does not depend on relative wages (so that $q^U_{\omega_U/\omega_I} = 0$), then $\partial\omega_S/\partial\omega_I = 0$. The optimal wage for skilled workers will depend in that case only on the minimum wage.[10] In addition, if the quit rate for skilled workers is independent of the level of unemployment ($q^S_{u_S} = 0$), then $\partial\omega_S/\partial\omega_I = \partial\omega_S/\partial\omega_U = 0$.

Fig. 1 shows the determination of the optimal wage. Curve WSC is the wage-setting condition (Eq. (6)) and has a positive slope. n^d_S is the labor demand curve given in Eq. (7), which has a negative slope. The equilibrium wage is obtained at E. An increase in the informal sector wage shifts the n^d_S curve to the left, with no effect on the WSC curve. The net result is a reduction in ω_S (as given at point E').

[10] A relationship such as Eq. (9) can also be derived from other models of wage determination—as, for instance, in an efficiency wage model where effort is related positively to the wage ratio and inversely to the unemployment rate. In such a setting, reducing the premium over the informal sector wage would have an adverse effect on the firm's profitability by reducing the level of effort produced by those remaining on the job. Yet another approach to deriving an equation similar to Eq. (9) would be, as in Agénor (1998), to assume that a trade union operates in the exportable sector.

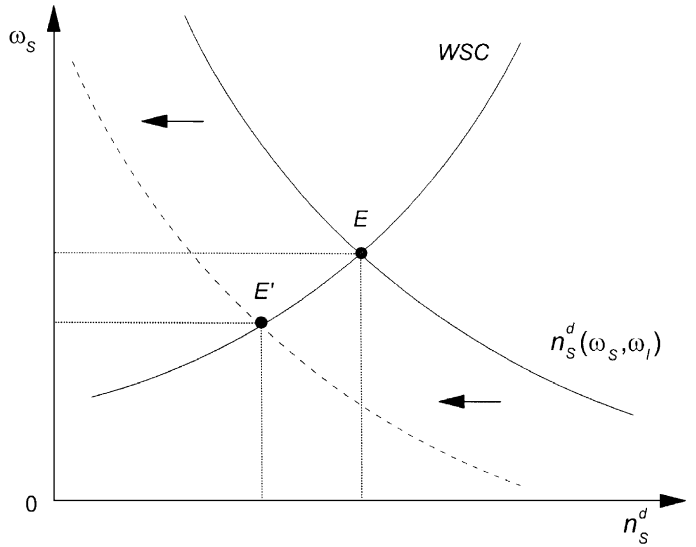

Fig. 1. Determination of the equilibrium wage for skilled workers.

In what follows, it will be assumed that $q^{S}_{u_S}$ is strictly positive. Nevertheless, as can be expected, whether ϕ_U or q_{ω_U/ω_I} are small or large plays an important role in the dynamics of policy shocks.

Substituting Eq. (8) in Eq. (1) yields output of the representative producer as

$$Y^{s}_{E} = Y^{s}_{E}\left(\overline{\omega}_I; \overset{?}{\omega}_U\right). \tag{10}$$

2.2. Output and price formation in the informal sector

Production in the informal sector Y_I depends only on labor and is characterized by decreasing marginal returns:

$$Y_I = y_I(n_I), \quad y'_I > 0, \quad y''_I < 0, \tag{11}$$

where n_I denotes the quantity of labor employed in the informal economy.

The representative producer maximize profits given by $z^{-1}Y_I - \omega_I n_I$, where ω_I denotes the real wage in the informal sector measured in terms of the price of exported goods, and $z = E/P_I$, the relative price of exportables in terms of informal sector goods, which will be referred to as the real exchange rate. Profit maximization yields the familiar equality between marginal revenue and marginal cost, $\omega_I = y'_I/z$, from which labor demand can be derived as

$$n^{d}_{I} = y'^{-1}_{I}(\omega_I z) = n^{d}_{I}(\omega_I z), \quad n^{d\prime}_{I} < 0, \tag{12}$$

where $\omega_I z$ measures the product wage in the informal sector. Substituting Eq. (12) in Eq. (11) yields the representative producer's supply function for goods produced in the informal sector:

$$Y_I^s = Y_I^s(\omega_I z). \qquad Y_I' < 0. \tag{13}$$

Using Eqs. (10) and (13), net factor income y is

$$Py = EY_E^s(\omega_I; \omega_U) + P_I Y_I^s(\omega_I z), \tag{14}$$

where P is the price of the consumption basket (derived below).

2.3. Household

There is only one household in this economy, whose members consist of all workers, skilled and unskilled. The consumption decision of the household is assumed to follow a two-step process. It determines first the optimal level of total consumption, and then allocates that amount between consumption of the home good and the imperfectly substitutable imported good.

The representative household's discounted lifetime utility is given by

$$\int_0^\infty \left\{ \frac{c^{1-\eta}}{1-\eta} + \ln m \right\} e^{-\rho t} dt, \qquad \eta > 0, \quad \eta \neq 1, \tag{15}$$

where ρ denotes the rate of time preference (assumed constant), c total real consumption, and m real money balances.

Real financial wealth of the household, a, is defined as

$$a = m + b + b^*, \tag{16}$$

where b denotes real holdings of government bonds, and b^* real holdings of foreign bonds, both measured in terms of the price of the consumption basket. Specifically, $b^* = EB^*/P$, where B^* represents holdings of foreign bonds measured in foreign-currency terms. The flow budget constraint is given by

$$\dot{a} = y - c - \tau + ib + (i^* - \iota + \varepsilon) b^* - \pi a, \tag{17}$$

where τ denotes the real value of lump-sum taxes, i the domestic nominal interest rate, i^* the exogenous, risk-free interest rate on foreign bonds, and $\pi \equiv \dot{P}/P$ the domestic inflation rate. The term $-\pi a$ accounts for capital losses on total wealth resulting from inflation, whereas the term εb^* represents the capital gain on the stock of foreign bonds resulting from exchange rate depreciation. The term ιb^*, where $0 < \iota < 1$, represents taxes on foreign bonds. The tax rate ι is endogenous and depends positively on actual holdings of foreign assets:[11]

$$\iota = \iota(b^*, \cdot), \quad \iota_{b^*} > 0. \tag{18}$$

[11] ι may also depend on other factors (such as the household's demographic characteristics), which are left unspecified here.

In the first stage of the consumption decision process, households treat π, ε, y, i, i^* and τ as given, and maximize Eq. (15) subject to Eqs. (16), (17) and (18) by choosing a sequence $\{c, m, b, b^*\}_{t=0}^{\infty}$. Let $r = i - \pi$ denote the domestic real rate of interest and $\sigma = 1/\eta$ the intertemporal elasticity of substitution. The optimality conditions are

$$c^{\eta}/m = i \quad \Rightarrow \quad m = m\left(\overset{+}{c}, \overset{-}{i}\right), \tag{19}$$

$$i = i^* - \iota + \varepsilon - b^* \iota_{b^*}, \tag{20}$$

$$\dot{c}/c = \sigma(r - \rho), \tag{21}$$

together with the transversality condition $\lim_{t \to \infty}(e^{-\rho t} a) = 0$.

Conditions (19) and (21) are familiar. Eq. (19) equates the marginal rate of substitution between consumption and real money balances to the opportunity cost of holding money. It can be solved to relate the demand for money positively to the level of transactions (as measured by total consumption expenditure) and negatively to the domestic nominal interest rate. Eq. (21) is the Euler equation, which relates the rate of change in consumption to the difference between the domestic real interest rate and the discount rate.

The novelty here is Eq. (20), which is the interest rate parity condition that holds under capital controls and the assumption that the household internalizes the effect of its portfolio decisions on the tax rate that it faces. It shows that in equilibrium, the household must equate the rate of return on domestic bonds to the domestic-currency value of the rate of return on foreign bonds, which consists of the sum of the interest rate on foreign bonds i^* and the devaluation rate ε, minus the tax rate ι and the increase in tax liabilities induced by a marginal increase in foreign assets—which is given by the product of the level of assets b^*, and the marginal increase in the tax rate, ι_{b^*}.[12]

Using the linear approximation $\iota \simeq \iota_{b^*} b^*$ to the tax function, Eq. (20) can be solved for the optimal demand of foreign bonds:

$$b^* = (i^* + \varepsilon - i)/\gamma, \tag{22}$$

where $\gamma \equiv 2\iota_{b^*} > 0$. Eq. (22) indicates that real holdings of foreign bonds depend on the difference between the domestic interest rate and the gross rate of return on foreign assets—given by the sum of the foreign interest rate and the devaluation rate. When $\iota_{b^*} \to 0$ (that is, the tax rate is independent of b^*), $\gamma \to 0$ and Eq. (22) yields the uncovered interest parity condition $i = i^* + \varepsilon$.[13]

[12] It should be noted that, in practice, the effectiveness of taxes on foreign assets would eventually erode over time, as agents learn how to evade them. The analysis here should thus be viewed as being cast in a time frame within which taxation remain effective.

[13] Turnovsky (1985) offered a specification that leads to an asset demand function analytically similar to Eq. (22). See also Agénor (1997) for a derivation based on individual default risk.

In the second stage of the consumption decision process, the representative household's allocation rule is[14]

$$c_{\mathrm{I}} = \delta z^{1-\delta} c, \quad c_{\mathrm{M}} = (1-\delta) z^{-\delta} c, \tag{23}$$

where $0 < \delta < 1$. c_{I} denotes individual purchases of the informal sector good and c_{M} expenditure on the imported good.

2.4. Prices and the market for home goods

The consumer price index, P, can thus be defined as:

$$P = P_{\mathrm{I}}^{\delta} E^{1-\delta} = E z^{-\delta}, \tag{24}$$

so that

$$\pi = \varepsilon - \delta \dot{z}/z. \tag{25}$$

The equilibrium condition of the market for informal sector goods can thus be written as

$$Y_{\mathrm{I}}^{\mathrm{s}} = \delta z^{1-\delta} c. \tag{26}$$

Using Eqs. (14) and (24) yield total income as

$$y = z^{\delta}\left(Y_E^{\mathrm{s}} + z^{-1} Y_{\mathrm{I}}^{\mathrm{s}}\right). \tag{27}$$

2.5. Wage formation and labor market equilibrium

The process of wage formation varies across segments of the labor market. As indicated above, both the minimum wage paid to unskilled workers in the exportable sector and the wage earned by public sector employees are assumed fixed by the government.[15] The skilled workers' wage is determined by firms so as to reduce turnover costs, as explained above. Firms in that sector also determine the level of employment of both categories of labor.

Consider now the informal labor market. The demand for labor is derived from profit maximization and is given by Eq. (12). Both categories of workers first queue up for employment in the formal sector.[16] But whereas unskilled workers

[14] The expressions in Eq. (23), which specify constant expenditure shares, are derived under the assumption that the sub-utility function is Cobb–Douglas and that the budget constraint is given by $P_{\mathrm{I}} c_{\mathrm{I}} + E c_{\mathrm{M}} = P c$.

[15] Assuming that the minimum wage is fully indexed to the price of exportable goods rather than the overall price level allows us to abstract from supply-side effects induced by the impact of changes in the price of exports (relative to the price of the consumption basket) on the cost of unskilled labor.

[16] This assumption requires that both the skilled workers' wage and the minimum wage be higher than the informal sector wage. It should be noted, however, that in practice the second condition may not hold for the "upper-tier" segment of the informal economy. See, for instance, Yamada's (1996) discussion of the Peruvian case.

who are unable to find a job in that sector move immediately to the informal economy, unsuccessful job seekers among the skilled labor force opt to remain unemployed.[17] With n^s denoting the total supply of labor, the supply of unskilled workers is $n_U^s = n^s - n_S^s$. The equilibrium condition of the labor market in the informal economy is thus given by

$$n_U^s - n_U^d = n_I^d(\omega_I z), \tag{28}$$

which, using Eqs. (8) and (9), can be solved to yield:[18]

$$\omega_I = \kappa\left(\bar{z}; \overset{?}{\omega}_U\right), \quad |\kappa_z| < 1, \tag{29}$$

and $|\kappa_z| = \tilde{\omega}_I$ if ϕ_U or $q^S_{\omega_U/\omega_I} = 0$.[19] Eq. (29) indicates that a depreciation of the real exchange rate has a negative effect on the market-clearing wage in the informal sector. The effect of z on informal sector wages is both direct and indirect. On the one hand, a reduction, say, in the relative price of informal sector goods (a rise in z) requires a direct, offsetting reduction in ω_I to keep labor demand constant and maintain equilibrium in the informal sector labor market. On the other, because the demand for unskilled workers in the formal sector rises as a result (as long as ϕ_U and $q^S_{\omega_U/\omega_I} > 0$), labor supply in the informal sector falls—offsetting to some extent the initial downward effect on wages in that sector. An increase in the minimum wage, as noted earlier, has an ambiguous effect on the demand for unskilled workers in the exportable sector—and thus on wages in the informal sector. If unit turnover costs ϕ_U or the sensitivity of the quit rate of unskilled workers q_{ω_U/ω_I} are sufficiently small, the direct (negative) effect of a higher minimum on labor demand in the formal economy will dominate; the resulting increase in labor supply in the informal economy will lead to an unambiguously negative effect on the market-clearing wage.

From Eq. (29), it can be shown that, with ϕ_U and $q^S_{\omega_U/\omega_I} > 0$, $d(z\omega_I)/dz = \tilde{\omega}_I + \kappa_z > 0$. This result, which plays an important role in what follows, can be summarized in the following proposition.

[17] Evidence supporting this assumption can be found in a variety of studies. Hirata and Humphrey's (1991) study of industrial workers in Brazil indicates that skilled workers are more likely than other categories to remain in open unemployment, rather than working in the informal sector. The evidence for India reviewed by Banerjee and Bucci (1995) also suggests that the more educated workers are more likely to engage in unemployed search. Additional evidence—for countries such as Chile, Morocco, and Thailand—is discussed by Agénor (1996), Horton et al. (1994), and the World Bank (1995). As indicated earlier, a combination of factors may account for this. In general, they imply thay the informal sector wage adjusted for the disutility of effort—that is, the opportunity cost of leisure—is lower than the expected return from remaining unemployed.

[18] In what follows, the initial steady-state value of the real exchange rate is normalized to unity.

[19] Specifically, $\kappa_z = -n_I^{d\prime}\tilde{\omega}_I/[n_I^{d\prime} + (\partial n_U^d/\partial_{\omega_I})]$. Note that the direct, adverse effect of an increase in ω_I on informal sector employment (through a reduction in the demand for labor) is compounded by the indirect negative effect on the demand for unskilled labor in the formal sector (resulting from an increase in the quit rate and turnover costs), which raises labor supply in the informal economy.

Proposition 2. *A depreciation (appreciation) of the real exchange rate raises (lowers) the product wage in the informal sector.*

2.6. Government, the central bank, and the money market

There are no commercial banks in the economy. The role of the central bank is to devalue the nominal exchange rate at a constant rate and to operate the costless conversion, at any moment in time, of domestic (foreign) currency into foreign (domestic) currency. Because there is no domestic credit, the real money stock is defined as

$$m = z^{\delta} R^{*}, \tag{30}$$

where R^{*} is the central bank's stock of net foreign assets, measured in foreign currency terms. The central bank receives interest on its holdings of foreign assets. Its real profits Δ are therefore given by

$$\Delta = (i^{*} + \varepsilon) z^{\delta} R^{*}, \tag{31}$$

where $\varepsilon z^{\delta} R^{*}$ measures the real value of the revaluation gain on reserves.

The government's revenue sources consist of taxes on private holdings of foreign assets, lump-sum taxes on households, and transfers from the central bank. It consumes imported goods and services its domestic debt. The flow budget constraint of the government can be written as, using Eq. (24):

$$\pi m + \dot{b} = z^{\delta} g_{\mathrm{I}} + rb - \iota b^{*} - \tau - (i^{*} + \varepsilon - \pi) z^{\delta} R^{*}, \tag{32}$$

where g_{M} measures government spending on imports. Eq. (32) indicates that government spending on goods plus net interest payments on domestic debt, minus lump-sum taxes, proceeds from the taxation of private foreign assets, and real interest income on foreign reserves, must be financed by the inflation tax or issuance of bonds.

Finally, using Eq. (19), the equilibrium condition of the money market can be solved for the domestic interest rate:

$$i = i\left(\overset{+}{c}, \overset{-}{m}\right). \tag{33}$$

Eq. (33) indicates that an increase in private spending requires a rise in the nominal interest rate to maintain money market equilibrium, whereas an increase in the real money stock necessitates a fall in interest rates.

3. Dynamic structure

In order to examine the dynamic properties of the model described in the previous section, it is convenient to rewrite it in a more compact form. Suppose

that the government foregoes the issuance of bonds to finance its deficit and instead varies lump-sum transfers to balance the budget. As shown in Appendix A, the dynamics of the model can then be formulated in terms of consumption and the representative household's wealth measured in foreign-currency terms—or equivalently here, the sum of the foreign-currency value of foreign assets held by the private sector and the central bank. Saddlepath stability of the model is also established in Appendix A.

The steady-state equilibrium of the model is depicted in Fig. 2. The *NN* curve in the North–West quadrant depicts combinations of consumption and the real exchange rate that are consistent with equilibrium in the market for informal sector goods (Eq. (A4)), whereas the *LL* curve in the South–West quadrant depicts combinations of the informal sector wage and the real exchange rate that are consistent with equilibrium in the informal labor market (Eq. (29)). In the North–East quadrant, the locus $[\dot{F} = 0]$ depicts the combinations of c and F for which holdings of foreign assets remain constant, whereas the locus $[\dot{c} = 0]$ depicts the combinations of c and F for which private consumption does not

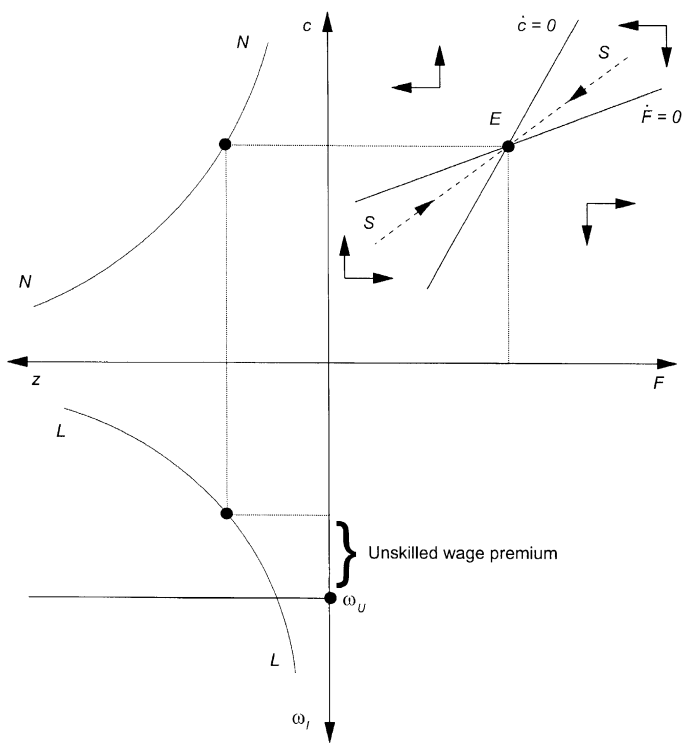

Fig. 2. Steady-state equilibrium.

change over time. Saddlepath stability requires that the $[\dot{c}=0]$ curve be steeper than the $[\dot{F}=0]$ curve. The saddlepath *SS* has a positive slope and defines the only convergent path to the steady-state equilibrium (point *E*).

A more detailed graphical illustration of the equilibrium of the labor market is presented in Fig. 3. Panel A depicts the demand functions for labor in the formal sector. The demand curve for skilled labor n_S^d is downward sloping, because it is negatively related to ω_S, the wage earned by skilled workers. The demand for unskilled labor n_U^d shown in the same panel is also downward sloping, because skilled and unskilled workers are gross complements. By subtracting n_U^d from the total supply of unskilled workers n_U^s, panel B gives the supply of labor (and thus

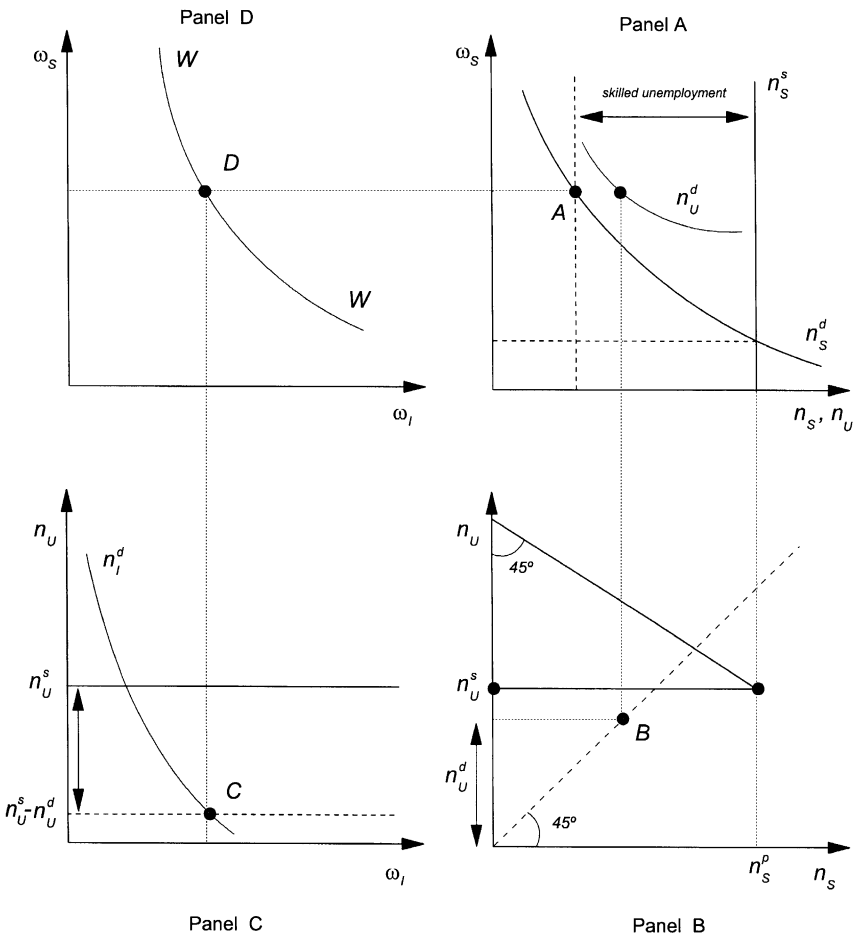

Fig. 3. Equilibrium of the labor market.

actual employment) in the informal economy. Given the downward-sloping labor demand curve in the informal sector n_I^d, the market-clearing wage—for a given level of the real exchange rate—is determined at point *C*. The negative relationship between the skilled workers' wage and the informal sector wage (for ϕ_U and $q_{\omega_U/\omega_I} > 0$) is displayed as curve *WW* in panel D (Eq. (9)). As shown in panel A, unemployment of skilled workers prevails in equilibrium and is given by the distance between the total supply of skilled labor, n_S^s, and the equilibrium point on the demand curve, n_S^d.

The steady-state solution of the model is obtained by setting $\dot{c} = \dot{F} = 0$. From Eq. (25), the steady-state inflation rate is thus equal to the devaluation rate ($\tilde{\pi} = \varepsilon$). From Eq. (21), the real interest rate is equal to the rate of time preference:

$$\tilde{\imath} - \varepsilon = \rho. \tag{34}$$

Substituting this result in Eq. (22) yields

$$\tilde{b}^* = (i^* - \rho)/\gamma, \tag{35}$$

which shows that the steady-state stock of foreign bonds held by the domestic household is positive as long as it has a lower preference for the present (or is more patient) than foreign households ($\rho < i^*$). From Eq. (34), steady-state real money balances $\tilde{m}$ are given by

$$\tilde{m} = m(\tilde{c}, \rho + \varepsilon). \tag{36}$$

4. Reduction in the devaluation rate

We now turn to an analysis of the impact and steady-state effects of a stabilization program based on a permanent reduction in the devaluation rate.[20] We emphasize the effects of this shock on wages, the sectoral composition of employment, and unemployment.[21]

Consider then a permanent, unanticipated reduction in the devaluation rate with no discrete change in the level of the exchange rate. The long-run effect of a reduction in is a proportional reduction in the domestic nominal interest rate. It thus has no effect on private demand for foreign assets, as indicated by Eq. (35). However, because it lowers the opportunity cost of money, it leads to an increase

[20] Technical details related to the impact and steady-state effects are provided in an expanded version of this paper (available upon request).

[21] In the discussion below, it is implicitly assumed that (a) downward movements in the skilled workers' wage are not large enough to result in a situation in which it is lower than the minimun wage and the informal sector wage, and (b) upward movements in the informal sector wage are not large enough to reverse the inequality $\omega_U > \omega_I$. These assumptions rule out "regime switching".

in domestic money demand (see Eq. (36)). The increase in the real money stock requires a rise in the central bank's foreign exchange reserves, that is (because b^* does not change), an increase in the economy's total holdings of foreign assets. To maintain external balance (at the initial level of the real exchange rate), private consumption must increase. The real exchange rate therefore appreciates, thereby raising real wages for workers in the informal economy and lowering the product wage there. Employment in the informal sector increases, whereas skilled workers' wage and demand for both categories of labor in the formal economy fall. Open unemployment therefore increases.

On impact, the reduction in the devaluation rate lowers the rate of return on foreign assets and leads to an instantaneous reallocation of portfolios away from foreign bonds and toward domestic money holdings. This portfolio shift—which leaves the economy's stock of foreign assets constant—puts downward pressure on the domestic interest rate to maintain equilibrium in the money market (see Eq. (33)). Graphically, as shown in Fig. 4, a reduction in the devaluation rate leads to a rightward shift in the $[\dot{c} = 0]$ curve. Private consumption jumps downward, from

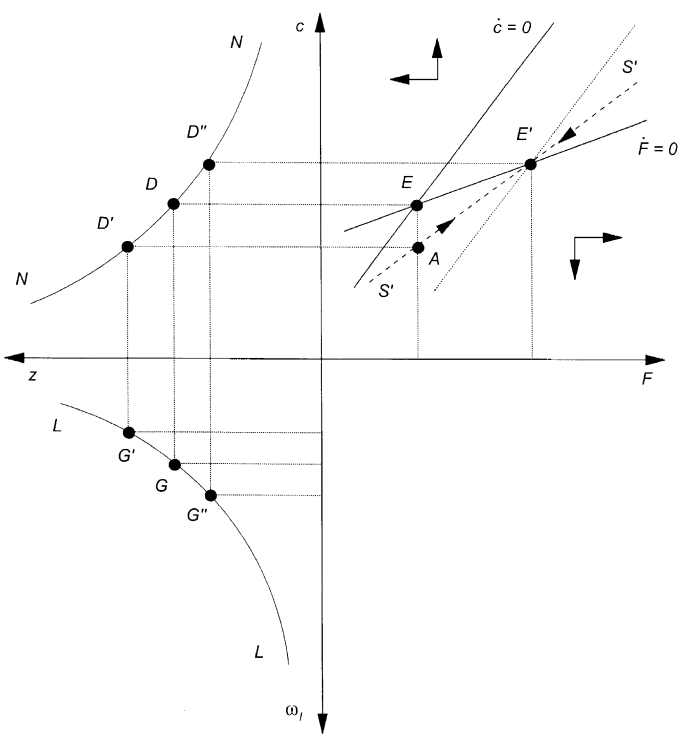

Fig. 4. Reduction in the devaluation rate.

point E to point A. The fall in private expenditure requires a depreciation of the real exchange rate to maintain equilibrium between supply and demand for informal sector goods.[22] Real wages in the informal sector therefore fall on impact. Nevertheless, as implied by Proposition 2, the product wage faced by producers in the informal economy rises. As a result, output and employment fall in that sector. The reduction in informal sector real wages raises demand for both categories of workers in the exportable sector, as well as skilled workers' wages. Output of exportable goods increases, skilled unemployment falls, and the distribution of employment of the unskilled labor force shifts toward the formal economy. The transitional effects of the shock on real wages and the real exchange rate operate in a direction opposite to the impact effects.

5. Concluding remarks

The role of the labor market in economic adjustment in developing countries has been the subject of renewed interest in recent years. The purpose of this paper has been to present a macroeconomic framework that captures some of the most salient features of this market and to assess the impact of stabilization policy on the behavior of wages and employment. The integrated model developed here captures, in particular, imperfect asset substitutability and the existence of a large informal sector. The labor market was assumed to be segmented as a result of minimum wage legislation. The model also assumed the existence of "luxury" unemployment, which captures the fact that those openly unemployed are more frequently the more educated (Horton et al., 1994). Unskilled workers cannot remain unemployed for long due to the lack of unemployment benefits, and tend to move to the informal sector, where entry is flexible.

The model was used to study the macroeconomic effects of a reduction in the nominal rate of devaluation. This type of policy has often figured in stabilization programs implemented in developing economies, but its impact on wages and employment have seldom been analyzed in a complete macroeconomic model with the type of labor market structure found in these countries. An important lesson of the analysis is that short- and long-term effects of stabilization programs on wages and employment may vary in opposite directions. A proper time frame is thus essential to analyze empirically the effects of adjustment policies on the labor market.

The analysis developed here could be extended in a variety of directions. First, as shown in an expanded version of this paper (available upon request) the model can be used to analyze the effects of public sector layoffs and an increase in the

[22] The reduction in consumption and the increase in real money balances combine to produce an initial drop in the nominal interest rate.

price of government services, under the assumption that the latter are used as production inputs in the formal sector.[23] The effects of an increase in the price of government services, for instance, are analyzed under the assumption that there is no substitution between these services and labor. In the long run, a permanent increase in the price of government services leads (at the initial level of wages and prices) to a reduction in the demand for both categories of labor in the formal sector. The resulting increase in labor supply in the informal economy puts downward pressure on wages there. This tends to raise output and to reduce the relative price of goods produced in the informal sector, that is, to depreciate the real exchange rate. The net effect is a reduction in the product wage in the informal economy, and thus higher output and employment. The reduction in informal sector wages tends to increase demand for both categories of labor in the exportable sector; but if the direct effect of a higher price of government services dominates, labor demand in the formal sector will unambiguously fall, and so will skilled workers' wages. In such a case, output of exportables will fall in the long run.

Second, the analysis could be extended to account for imperfect labor mobility and open unemployment of the unskilled labor force.[24] Third, the existence of distortionary income and output taxes should be accounted for. As emphasized in numerous studies, a distinguishing feature of the informal sector is the lack of compliance not only with labor regulations (as assumed here) but also the avoidance of tax payments. Modeling the tax system and its budgetary implications implies that intersectoral shifts in production, employment and factor income induced by some of the policy measures considered here would have "second-round" effects and would alter significantly the adjustment process. Finally, the analysis could be extended to account for labor supply decisions and capital accumulation, in order to assess the effect of changes in relative factor prices on investment and resource allocation. The increased dimensionality of the model would then necessitate recourse to numerical solution methods.

Acknowledgements

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[23] The model could be used also to analyze a reduction in the minimum wage, or external disturbances such as an increase in world interest rates. See Agénor and Aizenman (1999) for a related analysis of the effects of minimum wage changes in the presence of segmented labor markets, and Agénor (1997) for an analysis of external shocks.

[24] See Agénor (1998), who integrates in a simplified version of the present model a Harris–Todaro migration mechanism—which emphasizes expected income opportunities—across the formal and informal sectors to generate "wait" unemployment.

Latin American Macroeconomics Network Seminar held in Bogotá, Colombia (Sept. 19–20, 1997), as well as the editor and an anonymous referee for the very useful comments on a previous version. The views expressed in this paper are not to be interpreted as reflecting those of the World Bank.

Appendix A. Dynamic form and stability conditions

Suppose that the government foregoes the issuance of bonds to finance its deficit ($\dot{b} = 0$) and instead varies lump-sum transfers to balance the budget. Normalizing the constant level of domestic bonds to zero, Eq. (32) yields[25]

$$\tau = z^{\delta} g_{\mathrm{I}} - \iota b^{*} - (i^{*} + \varepsilon) z^{\delta} R^{*}. \tag{A1}$$

Substituting Eq. (27), the equilibrium condition of the market for informal sector goods (Eq. (26)), and the government budget constraint (Eq. (A1)) in the household's flow budget constraint (Eq. (17)) yields

$$\dot{a} = z^{\delta}(Y_E^{\mathrm{s}} - c_{\mathrm{M}} - g_{\mathrm{M}}) + (i^{*} + \varepsilon)(b^{*} + z^{\delta} R^{*}) - \pi a.$$

Because prices in the informal sector are fully flexible, z can jump in response to new information. Thus, because $a = z^{\delta}(R^{*} + B^{*})$, real wealth in domestic currency terms will also be subject to jumps. However, measured in foreign currency terms, real wealth cannot jump. Thus, let $F = R^{*} + B^{*}$, so that $a = z^{\delta} F$. Consequently, using Eq. (25):

$$\dot{a} = z^{\delta}(\dot{R}^{*} + \dot{B}^{*}) + (\varepsilon - \pi) a.$$

Combining the previous two equations, together with Eq. (23), yields

$$\dot{F} = i^{*} F + Y_E^{\mathrm{s}} - (1 - \delta) z^{-\delta} c - g_{\mathrm{M}}, \tag{A2}$$

which represents the consolidated flow budget constraint of the economy.[26]

[25] Normalizing the constant level of domestic bonds to zero is not entirely innocuous. As can be seen from the derivations below, a positive b would imply the possibiliy of jumps in real private financial wealth—except in the case where government bonds are denominated in foreign currency terms. Nevertheless, this complication is ignored, given the already complex nature of the model.

[26] Integrating Eq. (A2) yields the economy's intertemporal budget constraint, which requires, subject to the transversality condition $\lim_{t \to \infty}(\mathrm{e}^{-i^{*} t} F) = 0$, that the current level of foreign assets be equal to the discounted stream of the excess of domestic absorption of imported goods over output of exportables.

To determine the market-clearing solutions for the real exchange rate and wages in the informal sector, consider first the equilibrium condition of the market for informal sector goods (Eq. (26)). Solving this condition together with Eq. (13) yields the equilibrium value of z:

$$z = z(\bar{\omega}_I, \bar{c}). \qquad |z_{\omega_I}| < 1. \tag{A3}$$

The equilibrium condition of the informal labor market with "luxury" unemployment is given by Eq. (28) and the equilibrium value of ω_I is given by Eq. (29). Substituting this result in Eq. (A3) yields[27]

$$z = z(\bar{c}). \tag{A4}$$

The next step is to eliminate the real money stock and the private stock of foreign bonds from the system. First, note that from Eqs. (22), (30) and (33):

$$m = z^{\delta}(R^* + B^* - B^*) = z^{\delta}F - b^* = z^{\delta}F - [i^* + \varepsilon - i(c,m)]/\gamma.$$

Substituting out from Eq. (A4) for z yields, together with Eq. (A3):

$$m = \{\gamma z(c)^{\delta}F - (i^* + \varepsilon) + i_c c\}/(\gamma - i_m),$$

so that

$$m = \varphi\left(\overset{?}{c}, \overset{+}{F}; \bar{\varepsilon}\right). \tag{A5}$$

In what follows, it is assumed that $\varphi_c = (\delta\gamma z_c \tilde{F} + i_c)/(\gamma - i_m) > 0$. This condition holds if the initial level of foreign assets, $\tilde{F}$, is not too large.

Substituting Eq. (A5) in Eq. (21) yields

$$\dot{c}/c = \sigma\{i[c, \varphi(c; F; \varepsilon)] - \varepsilon + \delta\dot{z}/z - \rho\}. \tag{A6}$$

Eq. (A4) yields $\dot{z} = z_c\dot{c}$. Substituting this result in the above equation yields

$$\dot{c} = G\left(\overset{+}{c}, \overset{-}{F}; \overset{-}{\varepsilon}\right). \tag{A7}$$

Substituting Eqs. (9), (29) and (A3) in Eq. (10) yields

$$Y_E^s = y_E^s(\bar{c}),$$

with $\partial y_E^s/\partial c = 0$ if ϕ_U or $q^U_{\omega_U/\omega_I} = 0$.

Substituting this result, together with Eq. (A4) in Eq. (A2) yields

$$\dot{F} = i^* F + y_E^s(c) - (1-\delta)z(c)^{-\delta}c - g_M.$$

This equation can be written as

$$\dot{F} = i^* F + \Psi(\bar{c}) - g_M, \tag{A8}$$

[27] Note that $1 - z_{\omega_I}\kappa_z > 0$, since $|z_{\omega_I}| < 1$ and, from Eq. (29), $|\kappa_z| < 1$.

where

$$\partial \Psi / \partial c = \partial y_E^s / \partial c - (1 - \delta) + \delta(1 - \delta) z_c .$$

Eqs. (A7) and (A8) allow us to express the dynamics of the system in terms of private consumption and the economy's stock of foreign assets measured in foreign currency terms. A linear approximation around the steady state yields

$$\begin{bmatrix} \dot{c} \\ \dot{F} \end{bmatrix} = \begin{bmatrix} G_c & G_F \\ \Psi_c & i^* \end{bmatrix} \begin{bmatrix} c - \tilde{c} \\ F - \tilde{F} \end{bmatrix}. \tag{A9}$$

A necessary and sufficient condition for the system described by Eq. (A9) to be saddlepath stable is that the determinant $(G_c i^* - \Psi_c G_F)$ be negative. This condition is interpreted graphically in Fig. 2, and can be interpreted as requiring that the interest rate on foreign assets be sufficiently small to prevent an explosive behavior of consumption driven by large wealth effects.

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