Fiscal Adjustment and Labor Market Dynamics in an Open Economy

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Abstract

This paper studies the labor market effects of fiscal adjustment in a two-sector, three-good intertemporal model of a developing economy. Key features of the model are informal sector activities, minimum wages, a trade union in the formal economy, and public production of intermediate inputs. The unskilled labor force is imperfectly mobile across sectors. Unemployment of both skilled and unskilled workers emerges in equilibrium, despite wage flexibility in the informal sector. The steady-state effects associated with an increase in the price of government services are shown to depend in important ways on the degree of openness of the economy and trade union preferences. Transitional dynamics depend, in addition, on the speed of adjustment of the unskilled labor force between sectors and the sensitivity of the risk premium faced by domestic borrowers on world capital markets.

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1 Introduction

The failure to stabilize in developing countries is often viewed as the result of excessive government deficits financed by money creation. Policies aimed at fostering fiscal adjustment have thus figured prominently in programs of macroeconomic and structural reform. Austerity in the budgetary area has taken various forms, including cuts in public expenditure, reductions in real wages, increases in the relative price of public services, changes in the government's hiring and wage-setting policies, and the imposition of constraints on the growth in (or reductions in the level of) public sector employment. Because the public sector is a major employer in many developing countries, fiscal consolidation may have significant effects on wages and employment in the private sector. Understanding the mechanisms through which fiscal policies are transmitted to the labor market is thus an essential step in understanding the real effects of economic adjustment in developing countries.[1]

This paper attempts to contribute to this understanding by developing an open-economy macroeconomic framework that incorporates several important features. The first is the explicit consideration of informal sector activities, in which wages and prices are flexible. The informal sector has indeed grown in importance in many developing countries during the 1980s and early 1990s, as illustrated in Figure 1 for a group of Latin American countries. In a country like India, the proportion of employment in the formal or organized sector remains at less than ten percent of the labor force. Moreover, growth in formal sector employment has been dominated during the past two decades by the public sector (whose share increased from 67 percent in 1978 to 71 percent in 1993), whereas private sector employment in this sector has fallen in relative terms.

The short-run, macroeconomic implications of informal sector activities

[1]See Agénor (1996, 2000) and the World Bank (1995) for comprehensive accounts of the recent literature on the role of the labor market in economic adjustment.

has been the subject of much interest in recent years. Other important features of the model include public sector production and employment, a heterogeneous and imperfectly mobile unskilled labor force, and labor market segmentation induced by government regulations. As is the case in many developing countries (Nelson, 1994), trade unions play an important role in determining wages for some category of workers in the formal sector. In Ghana, for instance, labor unions have a powerful presence in the formal economy, in both the public and private sectors.

The remainder of the paper proceeds as follows. The analytical framework is presented in Section II. Its dynamic structure is described in a concise manner in Section III, with all mathematical details relegated to the Appendix. Section IV examines the impact and steady-state effects of an increase in the real price of government services. Section V summarizes the main results of the paper and discusses some possible extensions of the analysis.

2 The Model

Consider a small open economy in which there are four types of agents: producers, a household (whose members consist of skilled and unskilled workers), a trade union, and the government. The nominal exchange rate is kept fixed at E. There are two major segments in the economy, a formal sector and an informal sector.[2] In the formal economy two goods are produced: an exportable good, whose output is entirely sold abroad, and a nontraded government service.[3] Firms in the informal economy produce a nontraded

[2]The size of the formal and informal sectors is taken as given here. See Fortin, Marceau and Savard (1997) for a recent study in which the relative size of the informal economy is endogenously related to the level of taxes in the formal sector and the cost of tax evasion.

[3]As suggested by Agénor and Aizenman (1996), the absence of an import-competing sector in the formal economy can be rationalized by assuming that the efficiency losses induced by government-imposed barriers to foreign trade (which are not explicitly modeled here) are initially so high that goods that were once importables have effectively become nontraded goods.

good, which is used only for final consumption. The price of this good is flexible, and adjusts to eliminate excess demand. Production of the informal sector good and government services requires only unskilled labor, whereas production of exports requires both labor categories—as well as capital and government services as intermediate inputs.[4]

Public sector employment and the real wage earned by government employees (measured in terms of the price of exportables) are exogenously determined. In the exportable sector, the real wage earned by skilled workers, measured in terms of the consumption basket, is determined by a utility-maximizing trade union, whereas unskilled workers are paid a fixed minimum wage set by the government. For a given level of wages, firms in that sector determine employment levels of both categories of labor so as to maximize profits.

As a result of relocation and congestion costs, mobility of the unskilled labor force between the formal and the informal sectors is imperfect. Migration flows are determined by expected income opportunities, along the lines of Harris and Todaro (1970).[5] Specifically, the supply of unskilled workers in the formal sector is assumed to change gradually over time as a function of the expected wage differential across sectors. Wage and employment prospects are formed on the basis of prevailing conditions in the labor market. In line with the "luxury unemployment" hypothesis (Horton et al., 1994), skilled workers who are unable to obtain a job in the formal sector prefer to remain unemployed rather than seek employment in the informal economy.[6] In the

[4]The model can be extended to consider the case in which the public sector also employs skilled workers.

[5]For a recent review of the Harris-Todaro model and other developments in the migration literature on developing countries, see Bhattacharya (1993). For a more critical view of the Harris-Todaro model, see Stark (1991). Note that in the present setup the Harris-Todaro framework is used to explain migration flows between the (urban) informal sector and the (urban) formal sector, rather than migration between the rural and the urban sectors.

[6]Evidence supporting this hypothesis is provided also by Hirata and Humphrey (1991)

informal sector, which absorbs all unskilled workers who do not queue up for employment in the formal sector, wages adjust continuously to equilibrate supply and demand for labor. In both the short and the long run, therefore, "quasi-voluntary" unemployment of skilled workers and "wait" unemployment of unskilled workers may emerge. To ensure that all workers are willing to look for employment in the formal sector first (and thus avoid corner solutions), both the minimum wage and the wage set by the trade union for skilled workers are assumed to be strictly greater than the informal sector wage.

As indicated earlier, the government produces services that are used as intermediate inputs in the production of exportable goods. It fixes the real price (measured in terms of the domestic price of exportable goods) of its output, levies lump-sum taxes on the household, hires a constant share of the unskilled labor force, and sets production at a level that exceeds private demand for government services—thereby creating "labor hoarding" in the public sector. It finances its budget deficit by borrowing abroad. Finally, the household (or workers) supply labor inelastically and consume, in addition to the nontraded good produced in the informal sector, an imperfectly substitutable imported good whose price is fixed on world markets.

3 The Formal Economy

As indicated above, production in the formal economy consists of an exportable good and government services. The world price of exportables is exogenous and normalized to unity for simplicity. The domestic price of ex-

for Brazil and Banerjee and Bucci (1995) for India. Agénor (1996) provides a review of the evidence on skilled unemployment in developing countries. In general, whether skilled workers who are not successful in applying for a job in the formal sector decide to seek employment (as unskilled workers) in the informal economy depends on factors such as the efficiency of on-the-job search activities, demotivation effects, and the degree of support from relatives.

portables is thus equal to the nominal exchange rate, E. Production in the exportable sector is characterized by fixed proportions between government services (which are used as intermediate inputs) and gross output Y_E, and between a composite bundle of skilled and unskilled labor and Y_E. No substitution can therefore take place between government services, on the one hand, and the composite bundle of labor services, on the other, neither in the short run nor in the long run.[7] Let G denote the flow of government services, and n_S and n_U employment levels of skilled and unskilled labor (measured in natural units). We thus have

$$Y_E = \min[sV(n_S, n_U),\ \alpha G], \quad s, \alpha > 0 \tag{1}$$

where V is linear homogeneous in n_S and n_U with partial derivatives $V_{n_S}, V_{n_U} > 0, V_{n_S n_S}, V_{n_U n_U} < 0$. The assumption of linear homogeneity (or constant returns to scale) implies that $V_{n_S n_U} > 0$, so that skilled and unskilled labor are Edgeworth complements in the production of value added.[8] Efficient combination of factors therefore yields

$$Y_E = sV(n_S, n_U), \quad G^d = Y_E/\alpha, \tag{2}$$

where G^d denotes the demand for government services.

Let w_S be the nominal wage paid to skilled workers employed in the exportable sector, ω_m the real minimum wage earned by unskilled workers (measured in terms of the price of exportables) and P_G the nominal

[7] As a result, the adverse effects of an increase in the domestic price of government services (analyzed below) are magnified. A more general specification would be to assume that the production function is linearly homogeneous in all factors of production, as in Barro (1990). However, the absence of substitutability between government services and private inputs may be quite appropriate here, given the time frame of the analysis. Using a more general production function and at the same time assuming a low elasticity of substitution between each labor category and government services would yield qualitatively similar results to those obtained here.

[8] See Agénor (2001) for a more detailed discussion of this assumption. Or course, the assumption that labor inputs are gross complements does not prevent them from being Hicks-Allen substitutes.

price of government services. Suppose, for simplicity, that there is only one firm producing exportables. The firm's profits are therefore given by $(E - P_G/\alpha)Y_E - w_S n_S - E\omega_m n_U$. Using (2), maximization with respect to n_S and n_U yields the following conditions, which equate the real net marginal product of each category of labor to the relevant product wage:

$$s(1 - p_G/\alpha)V_{n_S}(n_S, n_U) = \omega_S, \quad s(1 - p_G/\alpha)V_{n_U}(n_S, n_U) = \omega_m,$$

where ω_S is the real wage earned by skilled workers and $p_G = P_G/E$ the real price of government services, both measured in terms of the price of exportables. p_G is assumed exogenous in what follows.[9] From the above equations, and given the second-order profit maximization condition $V_{SS}V_{UU} - V_{SU}^2 > 0$, the demand functions for labor can be derived as

$$n_S^d = n_S^d(\bar{\omega_S}; \bar{\omega_m}, \bar{p_G}), \quad n_U^d = n_U^d(\bar{\omega_S}; \bar{\omega_m}, \bar{p_G}). \tag{3}$$

Equations (3) indicate that an increase in the product wage for either category of workers, or a rise in the real price of government services, reduces the demand for both categories of labor.

Substituting these results in equation (2) yields

$$Y_E^s = Y_E^s(\bar{\omega_S}; \bar{\omega_m}, \bar{p_G}). \tag{4}$$

Net supply of exportables, Q_E^s, is equal to gross supply minus the cost of intermediate inputs. Measured in terms of the price of exportables, and using equations (2) and (4),

$$Q_E^s = (EY_E^s - P_G G^d)/E = (1 - p_G/\alpha)Y_E^s(\omega_S; \omega_m, p_G). \tag{5}$$

[9]The choice of units is assumed to be such that $1 > p_G/\alpha$, to ensure that value added (defined below) is positive.

Production of government services requires only unskilled labor. The public sector workforce is assumed fixed at n_G. For a given real price (measured in terms of the price of exportables) p_G, output of public sector services is demand determined from equations (2) and (4). Assuming a linear production function and a labor-output ratio in the public sector equal to α_G, actual employment is assumed to be such that $\alpha_G G^d < n_G$. Thus, in general, disguised unemployment prevails in the public sector.[10]

3.1 The informal sector

Technology for the production of the nontraded good in the informal sector is characterized by decreasing returns to labor:

$$Y_N = y_N(n_N), \quad y'_N > 0, \; y''_N < 0, \tag{6}$$

where Y_N denotes output of home goods, and n_N the quantity of labor employed. Suppose, again for simplicity, that there is only one firm operating in the informal economy. The firm's profits are given by $z^{-1}Y_N - \omega_N n_N$, where ω_N denotes the real wage (measured in terms of the price of exportables) prevailing in the informal sector, and $z \equiv E/P_N$ the real exchange rate, defined as the ratio of the domestic price of exportables to the price of home goods (P_N). Profit maximization yields the familiar equality between marginal revenue and marginal cost, $\omega_N = y'_N/z$, from which labor demand can be derived as

$$n_N^d = y_N'^{-1}(\omega_N z) = n_N^d(\omega_N z), \quad n'_N < 0, \tag{7}$$

[10] As discussed by Agénor (1996, 2000), this feature of the labor market has been observed in many developing countries. Endogenizing the factors affecting the determination of public sector unemployment is beyond the scope of this paper. See Rodrik (1998) for a discussion of two alternative views, the rent-seeking hypothesis (which argues that governments tend to use public sector employment as an instrument for creating and allocating rents) and the risk-insurance hypothesis (which views public sector employment as an insurance device against undiversifiable risk).

where $\omega_N z$ measures the product wage in the informal sector. Substituting equation (7) in (6) yields the firm's supply function:

$$Y_N^s = Y_N^s(\omega_N z). \quad Y_N' < 0 \tag{8}$$

3.2 Household

As indicated earlier, skilled and unskilled workers (all belonging to the same household) supply labor inelastically, and consume both home and imported goods. The consumption decision process is assumed to follow a two-step process. First, the household determines the optimal level of total consumption based on intertemporal optimization, subject to a flow budget constraint. Second, it allocates that amount between consumption of the home good and the imperfectly substitutable imported good.

The household's discounted lifetime utility is given by

$$\int_0^\infty \frac{c^{1-\eta}}{1-\eta} e^{-\rho t} dt, \quad \eta > 0, \ \eta \neq 1 \tag{9}$$

where c denotes total consumption (measured in terms of exportables), ρ the rate of time preference (assumed constant), and $\sigma = 1/\eta$ the intertemporal elasticity of substitution.

The household can borrow (with loans of infinite maturity) on world capital markets, at the rate i^*. Let D_H^* denote the foreign-currency value of the household's stock of debt. The flow budget constraint of the household can thus be written as

$$\dot{D}_H^* = i^* D_H^* + c + \tau - q, \tag{10}$$

where q is net factor income (defined below), i^* the cost of borrowing on the world capital market, and τ real lump-sum taxes. Both q and τ are measured in terms of exportables.

The world capital market is assumed to be imperfect. Specifically, it is assumed that the interest rate facing domestic borrowers is the sum of a risk-free rate, i_f^*, and a country-risk premium, which varies positively with the economy's total foreign debt, D^*:

$$i^* = i_f^* + \kappa(D^*), \tag{11}$$

where $\kappa' > 0$, and $\kappa'' > 0$. Another approach would be, following Murphy (1991), to introduce the ratio of debt to output of exportables, D^*/Y_E^s, as a determinant of the risk premium. Yet another approach might be, following Agénor and Aizenman (1999) and Agénor and Santaella (1996), to introduce the steady-state ratio of traded-to-nontraded output in addition to foreign debt as a determinant of the premium. The latter specification captures the idea that the world interest rate faced by a small country also depends inversely on its 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. Both extensions, however, would make the analysis more complex with little additional insight.[11]

In the first stage of the consumption decision process, the household treats q, i^* and τ as given, and maximizes (9) subject to (10), by choosing a sequence $\{c\}_{t=0}^{\infty}$. The optimality condition is the familiar one relating the rate of change in consumption to the difference between the marginal cost of borrowing (given by (11)) and the discount rate:

$$\dot{c}/c = \sigma[i_f^* + \kappa(D^*) - \rho]. \tag{12}$$

[11] Regardless of the particular specification chosen, the endogeneity of the foreign interest rate is critical for the stability of the model and the uniqueness of its steady state. With a constant world interest rate, the steady state would depend on initial conditions; in that case, a stable trajectory would exist, but the steady state toward which the economy evolves would depend on where it starts.

Ruling out Ponzi games also requires imposing the transversality condition $\lim_{t\to\infty}(e^{-\rho t}D_H^*) = 0$.

In the second stage of the consumption decision process, the household follows the allocation rule[12]

$$c_N = \delta z c, \quad c_M = (1-\delta)c, \tag{13}$$

where c_N denotes purchases of the informal sector good and c_M expenditure on the imported good and $0 < \delta < 1$. The appropriate cost-of-living index, P, can thus be defined as

$$P = P_N^{\delta} E^{1-\delta} = E z^{-\delta}. \tag{14}$$

Using equations (5) and (8) net factor income q can be defined as

$$q = Q_E^s + z^{-1} Y_N^s + \omega_G n_G, \tag{15}$$

where ω_G is the real wage earned by government workers (measured in terms of the price of exportables). $\omega_G n_G$ is thus the public sector wage bill. In what follows ω_G is assumed exogenous.

3.3 The labor market

As indicated earlier, 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.[13] To see how the wage earned by skilled

[12] As is well known, the allocation rule described in (13) is optimal if the sub-utility function in both goods is homogeneous of degree one. The constancy of expenditure shares results from the assumption that the sub-utility function is Cobb-Douglas.

[13] By assuming that the minimum wage is fully indexed on the price of exportables rather than the overall price level, the analysis abstracts from supply-side effects induced by the impact of changes in the relative price of exportables in terms of the consumption basket on the cost of unskilled labor in the formal economy. This assumption is not entirely innocuous, because the ratio of unskilled workers' wages in the formal and informal sectors determines the sectoral allocation of unskilled labor and the equilibrium unemployment rate.

workers in the exportable sector is determined, let ω_S^c denote the *consumption* wage, that is, the nominal wage earned by skilled workers deflated by the cost-of-living index. ω_S^c is assumed determined along the lines of the "monopoly union" approach. Specifically, ω_S^s is assumed set by a centralized labor union whose objective is to minimize a quadratic loss function that depends on deviations of employment and the consumption wage from their target levels, subject to the firm's labor demand schedule in the exportable sector.[14] Thus, the union solves the following decision problem:

$$\min_{\omega_S^c}(n_S - n_S^T)^2 + \nu(\omega_S^c - \omega_S^{cT})^2, \quad \nu > 0 \tag{16}$$

subject to the condition $n_S = n_S^d$, where n_S^d is given by equation (3).[15] The quantities ω_S^{cT} and n_S^T measure the union's wage and employment targets, respectively, and are both assumed constant.[16] The parameter ν reflects the relative importance that the union attaches to wage deviations, as opposed to employment deviations. It is assumed in what follows that $n_S^d < n_S^T$. Thus, the trade-off between the real wage and the level of employment arises because in the present setting the union's optimal outcome ($n_S = n_S^T$ and

[14]The analysis could be generalized to consider bargaining between firms and unions over wages, with firms setting employment (the so-called "right to manage" model). Considering a framework in which firms and unions bargain directly over both wages and the level of employment would be more involved. As is well known (see for instance Booth, 1995), efficient wage bargaining mechanisms of this type do not necessarily lead to an outcome consistent with firms being on their labor demand schedule.

[15]The assumption that deviations of employment and wages from their target values have symmetric effects on union preferences may not be warranted in practice but is adopted for simplicity.

[16]It could be assumed that the union's target wage is a weighted average of an exogenous wage level together with the expected income of workers who are unable to find employment in the exportable sector. In the present framework, there is no job turnover in the public sector, unemployment benefits do not exist, and entry in the informal sector is not subject to any barriers. Consequently, the expected "outside" income is simply the going wage in the informal sector. However, in the present setting, skilled workers always opt to remain unemployed if they cannot find work in the formal sector. Thus, there is no strong reason to assume that the union's target level should depend on the informal sector wage, although fairness considerations might be relevant here (Moene et al., 1993, p. 433).

$\omega_S^c = \omega_S^{cT}$) is inconsistent with the labor demand schedule, which defines the profit-maximizing level of employment.

Given the definition of the price level given above (Equation (14)), the product wage and the consumption wage are linked by the relation $\omega_S^c = z^\delta \omega_S$. Substituting this relation in (3), and maximizing with respect to ω_S^c the union's objective function (16) subject to (3)—with z taken as given—yields the union's desired (and actual) consumption wage:

$$\omega_S^c = \omega_S^c(\overset{+}{\omega_S^{cT}}, \bar{\omega}_m, \bar{p}_G). \tag{17}$$

where, in particular, $\partial\omega_S^c/\partial\omega_S^{cT} = \nu/[\nu + (\partial n_S^d/\partial\omega_S)^2] < 1$.[17] Equation (17) indicates that the consumption wage set by the union is increasing in the target wage, and decreasing in the minimum wage and the price of government services. An increase in the minimum wage, for instance, lowers the demand for skilled labor (as a result of gross complementarity of labor inputs) and leads the union to reduce its desired wage. If unions cared only about real wages ($\nu \to \infty$), the wage set for skilled workers would be maintained continuously in line with its target level, ω_S^{cT}. On the other hand, the lower ν is (the more the union cares about employment), the higher will be the effect of negative shocks to labor demand on wages. In particular, the lower ν is, the higher will be the downward effect of an increase in p_G on the desired consumption wage.

Because $\omega_S^c = z^\delta \omega_S$, the product wage is given by

$$\omega_S = z^{-\delta}\omega_S^c(p_G), \tag{18}$$

and is negatively related to the real exchange rate and the price of government services. It is also important to note that the elasticity of the product wage to changes in the real exchange rate does *not* depend on the relative weight

[17] Partial derivatives are evaluated throughout at initial levels of the real exchange rate normalized to unity.

attached by the union to wage deviations in its utility function. It depends only on δ, the share of private consumption expenditure allocated to informal sector goods, or equivalently here the degree of openness.

Consider now the informal sector labor market. The demand for labor is derived from profit maximization and is given by equation (7). As indicated earlier, the supply of unskilled workers in the formal sector, denoted n_U^s, is predetermined at any moment in time. Thus, the supply of unskilled labor in the informal economy is also given at any point in time. Skilled workers who are unable to find a job in the formal sector opt not to seek employment in the informal economy.[18] The equilibrium condition of the labor market in the informal economy is thus given by

$$n_U^p - n_U^s = n_N^d(\omega_N z), \tag{19}$$

where n_U^p denotes the constant number of unskilled workers in the labor force. Solving this equation yields:

$$\omega_N = \upsilon(\underset{-}{z}, \underset{+}{n_U^s}), \quad \upsilon_z = -1, \tag{20}$$

which indicates that a depreciation of the real exchange rate has a negative effect on the market-clearing wage (which is such that the product wage remains constant), whereas an increase in the number of workers seeking employment in the formal economy has a positive effect. Thus, for n_U^s given, a real exchange rate depreciation has no effect on labor demand and output in the informal sector. This result is important to understand the short-run dynamics of policy shocks, as discussed below. With n_U^s constant on impact, any movement in z induced by a given shock generates an offsetting movement in ω_N.

[18] Because, again, there is no unemployment benefit scheme in the present framework, unemployed workers (skilled and unskilled) are implicitly assumed to either turn to a subsistence activity (home production) or to rely on other members of the household for their survival.

The mechanism through which unskilled workers migrate across sectors follows the formulation of Harris and Todaro (1970), and relates movements of labor to the expected wage differential between sectors.[19] Because there is no job turnover in the public sector, the expected wage in the formal economy is equal to the minimum wage weighted by the probability of being hired in the exportable sector. Assuming that hiring in that sector is random, this probability can be approximated by the ratio of currently employed workers to those seeking employment, $n_U^d/(n_U^s - n_G)$. The expected wage in the informal economy is simply the going wage, because there are no barriers to entry in that sector. Thus, the supply of unskilled workers in the formal sector evolves over time according to

$$\dot{n}_U^s = \beta \left\{ \frac{\omega_m n_U^d}{n_U^s - n_G} - \omega_N \right\}, \quad \beta > 0, \tag{21}$$

where β denotes the speed of adjustment. The absence of on-the-job search in the informal sector in the present setup can be justified in a variety of ways. An important consideration is the existence of informational inefficiencies, which may result from the absence of institutions capable of processing and providing in a timely manner relevant information on job opportunities to potential applicants. As a result, search activities for unskilled workers in the formal sector may require, literally speaking, waiting for job offers at factory gates.

3.4 The market for home goods

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

$$Y_N^s = c_N,$$

[19] Some evidence of queuing by informal sector workers for formal sector jobs as hypothesized by the Harris-Todaro mechanism is provided by Maloney (1997), in a study of labor market transitions in Mexico during the period 1987-93.

or, equivalently, using equations (8) and (13):

$$Y_N^s(\omega_N z) = \delta z c. \tag{22}$$

Solving condition (22) for the equilibrium real exchange rate yields

$$z = z(\bar{\omega_N}, \bar{c}), \quad |z_{\omega_N}| < 1, \tag{23}$$

which shows, in particular, that an increase in ω_N (for c given), by raising the product wage and lowering output supply in the informal sector, leads to a less than proportional an appreciation of the real exchange rate. An increase in private expenditure on informal sector goods also leads to a real appreciation.

Substituting (20) for ω_N in the above equation yields[20]

$$z = z(\bar{c}, \bar{n_U^s}). \tag{24}$$

Equation (24) shows that an increase in the size of the unskilled labor force seeking employment in the formal economy, by lowering labor supply in the informal sector and raising wages there, lowers output supply and creates excess demand for informal sector goods—thereby requiring an appreciation of the real exchange rate.

3.5 Government

Finally, the government pays salaries to public sector workers, and services its foreign debt, D_G^*. It derives revenue from the sale of public sector services and by levying lump-sum taxes on the household. It finances its deficit by borrowing on world capital markets, at the rate i^*:

$$\dot{D}_G^* = i^* D_G^* + \omega_G n_G - \alpha^{-1} p_G Y_E^s - \tau. \tag{25}$$

[20]Note that, because $v_z = -1$ and $|z_{\omega_N}| < 1$ from (23), $1 - z_{\omega_N} v_z > 0$.

4 Dynamic Form

To derive the compact dynamic form of the model, the first step is to note that substituting the value of q, given by (15), and τ from the government budget constraint (equation (25)) in the household's flow budget constraint (equation (10)) implies that

$$\dot{D}^* = i^* D^* + c - z^{-1} Y_N^s - Y_E^s,$$

where $D^* = D_H^* + D_G^*$ is the economy's total stock of debt. By definition, $c = c_M + z^{-1} c_N$. Substituting this result in the previous equation yields

$$\dot{D}^* = i^* D^* + c_M + z^{-1}(c_N - Y_N^s) - Y_E^s.$$

Using equations (4), (13), and noting that from the equilibrium condition for the market for home goods, equation (22), this expression can be written as

$$\dot{D}^* = i^* D^* + (1-\delta)c - Y_E^s(\omega_S; p_G). \tag{26}$$

The next step is to eliminate ω_S from the system. Substituting (24) in (18) yields

$$\omega_S = \Lambda(\overset{+}{c}, \overset{+}{n_U^s}; \overset{-}{p_G}), \tag{27}$$

which can in turn be substituted in the previous equation to give

$$\dot{D}^* = \Psi(\overset{+}{c}, \overset{+}{n_U^s}, \overset{+}{D^*}; \overset{?}{p_G}), \tag{28}$$

where

$$\Psi_c = (1-\delta) - \Lambda_c(\partial Y_E^s / \partial \omega_S), \quad \Psi_{n_U^s} = -\Lambda_{n_U^s}(\partial Y_E^s / \partial \omega_S),$$

$$\Psi_{D^*} = i_f^* + \kappa + \kappa' \tilde{D}^*, \quad \Psi_{p_G} = -[\Lambda_{p_G}(\partial Y_E^s/\partial \omega_S) + (\partial Y_E^s/\partial p_G)].$$

An increase in the price of government services has an ambiguous effect on the demand for skilled and unskilled workers, the supply of exportables, and thus the current account. On the one hand, it has a direct negative effect on labor demand and output in the exportable sector; on the other, it lowers the wage demanded by the union. If the union cares sufficiently about employment levels (as opposed to wages, so that ν is sufficiently small), the reduction in the wage demanded will be large, and the net, overall effect of p_G on output of exportables may even be positive.

Equation (12) can be written as

$$\dot{c}/c = \sigma[i_f^* + \kappa(D^*) - \rho] = G(D^*), \tag{29}$$

where $G' = \sigma\kappa' > 0$.

Consider now the Harris-Todaro migration equation, (21), which can be rewritten as, using (3) and (20):

$$\dot{n}_U^s = \beta \left[\frac{\omega_m n_U^d(\omega_S; p_G)}{n_U^s - n_G} - \omega_N(z, n_U^s) \right].$$

Using equations (24) and (27) to eliminate z and ω_S yields

$$\dot{n}_U^s = \beta H(\bar{c}, \bar{n_U^s}; \overset{?}{p_G}), \tag{30}$$

which shows, in particular, that an increase in n_U^s lowers migration flows to the formal economy. There are three effects at play here—the first, partial equilibrium in nature, and the other two general equilibrium in nature:

- An *employment prospect effect*. The increase in n_U^s raises the number of job seekers in the exportable sector; at a given level of labor demand in that sector, the employment probability falls. This effect tends to lower migration flows.

- A *labor supply effect*. The increase in n_U^s lowers labor supply in the informal sector, which tends to raise wages (and thus the opportunity cost of queueing, or expected income) in that sector. This effect tends also to lower migration flows.

- A *relative price effect*. The increase in n_U^s, by raising informal sector wages, dampens output in that sector—requiring a real exchange rate appreciation to maintain equilibrium of the market for informal sector goods. The real appreciation, in turn, has two effects. First, it raises the informal sector wage (thereby reinforcing the previous effect), which tends to reduce migration flows to the formal sector; second, it tends to lower the consumption wage, which then translates into a higher product wage for skilled workers. The increase in skilled workers' wage lowers the demand for unskilled labor (because labor inputs are complements)—which tends to reduce the expected wage in the exportable sector and thus migration flows to the informal economy.

An increase in the real price of government services, in general, has an ambiguous effect on migration flows—essentially because the net effect on the demand for unskilled labor (as noted earlier) cannot be signed a priori. The direct effect of an increase in p_G, because it reduces the demand for unskilled labor in the exportable sector n_U^d (and thus the probability of employment in that sector), is clearly negative; at the same time, however, the increase in p_G lowers the wage demanded by the union and thus the product wage for skilled workers in the exportable sector—thereby raising (as a result of the complementarity effect) the demand for unskilled labor in the formal economy. If the weight attached by the union to employment deviations is low (that is, if ν is sufficiently large), the direct effect will dominate.

Equations (28), (29) and (30) represent the compact dynamic form of the model. As shown in the Appendix, these equations can be written as a third-order differential equation system in c, D^*, and n_U^s. The variable

c is a jump variable, whereas D^* and n_U^s can change only gradually over time. Stability of this system, as also shown in the Appendix, requires that the speed of adjustment of the unskilled labor force across sectors, β, be sufficiently large–a condition that accords well with the available evidence.[21]

In the long-run equilibrium, with $\dot{c} = 0$, equation (29) implies that

$$\tilde{D}^* = (\rho - i_f^*)/\kappa', \tag{31}$$

which indicates that the more impatient domestic agents are (the higher ρ is), the higher the foreign debt will be. Setting $\dot{D}^* = 0$ in equation (26) and using (27) implies that in the steady state the current account must be in equilibrium:

$$i^*\tilde{D}^* + (1-\delta)\tilde{c} - Y_E^s[\omega_S(\tilde{c}, \tilde{n}_U^s; p_G); p_G] = 0. \tag{32}$$

Finally, equation (21) implies that in the steady state, with $\dot{n}_U^s = 0$, the ratio of wages earned by unskilled workers in the formal and informal sectors (hereafter the unskilled wage ratio) is equal to the inverse of the employment ratio of that category of labor in the private formal economy:

$$\omega_m/\tilde{\omega}_N = (\tilde{n}_U^s - n_G)/\tilde{n}_U^d. \tag{33}$$

This condition shows that, as long as the minimum wage is higher than the informal sector wage ($\omega_m > \tilde{\omega}_N$), unskilled unemployment will emerge in equilibrium.[22]

The adjustment process to the long-run equilibrium can be studied graphically by using a result due to Dixit (1980). As shown in the Appendix, the

[21]Evidence of a relatively high degree of mobility across the informal and formal sectors is provided, for instance, by Funkhouser (1997) for El Salvador.

[22]In the present setting, the condition that the minimum wage be higher than the market-clearing wage is in fact necessary to avoid a corner solution, that is, a situation in which no unskilled worker has any incentive to seek employment in the formal economy.

jump variable c can be eliminated from the dynamic system, thereby allowing an analysis of the adjustment process through the use of a phase diagram in n_U^s and D^*. This phase diagram and the steady-state equilibrium are illustrated in the right-hand panel of Figure 2, in the benchmark case discussed earlier. The locus D^*D^* gives the combinations of n_U^s and D^* for which external debt remain constant, whereas the locus LL depicts the combinations of n_U^s and D^* for which the supply of unskilled labor in the formal sector does not change over time. The steady-state equilibrium is obtained at point E. The left-hand panel shows the relationship between c and D^* implied by equation (29) with $\dot{c} = 0$. The locus shown in that panel is horizontal, because changes in the *rate of growth* of consumption are independent of the *level* of private expenditure.[23]

Suppose that the initial position is at point A, characterized by a current account deficit and a higher expected wage in the formal sector compared to the going wage in the informal economy. The adjustment process may entail a monotonic reduction in the level of external debt (associated with a sequence of current account surpluses), and an increase in the supply of unskilled labor in the formal sector, or a process through which a sequence of current account surpluses is followed by a sequence of external deficits. In the first case private consumption increases throughout the adjustment period (with $\dot{c} > 0$), whereas in the second it increases at first and falls subsequently.

A partial-equilibrium depiction of the long-run equilibrium position of the labor market is presented in Figure 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 curve for unskilled labor in the exportable

[23]It is worth noting that the condensed dynamic system in n_U^s and D^* described in the Appendix is useful only for analyzing the transitional dynamics of the full system in c, n_U^s and D^* .

sector, n_U^d, is also downward-sloping, because skilled and unskilled workers are gross complements. From (33) the long-run supply of unskilled workers in the formal sector, net of public sector employment, $n_U^s - n_G$, is given by the demand for unskilled labor in the exportable sector, times the unskilled wage ratio. This relationship is depicted in Panel B by curve HH, which has a positive slope that is greater than unity, as implied by the condition requiring the unskilled wage ratio to be greater than unity in equilibrium (equation (27)). Curve VV is given by $n_U^p - n_U^s$; it is thus a linear transformation of HH. It determines the supply of labor (and thus actual employment) in the informal economy (point B''). Given the labor demand curve in the informal sector n_N^d, the market-clearing wage is determined at point C in Panel C.[24] The positive relationship between the skilled workers' wage and the informal sector wage, as implied by equations (18) and (23), is displayed as curve WW in Panel D. Skilled unemployment is given in Panel A by the distance between the supply of skilled labor n_S^p and the equilibrium point on the demand curve n_S^d. The difference between points B (located on the 45-degree line) and B' (located on HH) in Panel B gives unskilled unemployment. Thus, unemployment of both categories of labor prevails in equilibrium—despite the existence of wage flexibility in the informal sector.

5 Fiscal Adjustment

The above framework can be used to study the impact and steady-state effects of a variety of fiscal policy shocks that have often been part of both stabilization and structural adjustment programs implemented in developing countries. The analysis here is confined to a permanent increase in the price of

[24]From equations (7) and (20), n_N^d is a function of z and n_U^s. From the equilibrium condition of the market for nontraded goods (equation (23)), z is negatively related to ω_N. Substituting this last result in (7) shows that the n_N^d curve is downward-sloping in the ω_N-n_U space.

government services and its effects on relative wages, the sectoral composition of employment, and unemployment.

5.1 Steady-state effects

Consider first the long-run effects of an increase in p_G. The first noticeable result is that such a shock, as implied by equation (31), has no effect on the economy's steady-state level of foreign debt. Second, using (32) and (33), it can be shown that the net effect on consumption and labor supply in the formal economy is ambiguous, regardless of whether the direct effect of an increase in p_G on the supply of exportables and the demand for unskilled labor in that sector is negative or not.

Consider first the "normal" case in which $\Psi_{p_G} > 0$ and $H_{p_G} < 0$. The increase in p_G (at the initial level of wages) tends to lower the supply of exportables and the demand for both skilled and unskilled labor in the exportable sector. Consumption tends to expand, at the initial levels of the real exchange rate and the supply of unskilled labor in the formal economy, to maintain current account equilibrium. As a result, the real exchange rate tends to depreciate to maintain equilibrium of the market for informal sector goods. At the initial level of labor supply in the informal sector, the real depreciation requires a fall in wages in that sector to maintain labor market equilibrium. At the same time, the reduction in the demand for skilled labor in the exportable sector induced by the increase in the price of government services tends to lower the desired consumption wage for skilled workers by the union; this tends to exert downward pressure on the product wage for skilled workers. Nevertheless, under the assumptions given above, the net effect on the demand for both categories of labor in the exportable sector is negative.

From equation (33), the supply of unskilled labor in the formal economy is given by the sum of public sector employment plus the actual level of unskilled

employment in the exportable sector weighted by the unskilled wage ratio. Because the unskilled wage ratio increases, and unskilled employment in the exportable sector falls, the net movement in the supply of unskilled labor in the formal economy is ambiguous. As a result, the general equilibrium effect of the shock on private consumption (and thus the real exchange rate and real wages in the informal sector) is ambiguous as well. All that can be inferred here (from equation (32)) is that, because $\tilde{D}^*$ does not change, private consumption must move in exactly the same direction as output of exportables to maintain current account equilibrium.

The same ambiguity in the long-run movement in c and n_U^s is obtained in the opposite case in which the direct, negative effect of an increase in p_G on the supply of exportables and the demand for unskilled labor in that sector is outweighed by the indirect, positive effect (so that $\Psi_{p_G} < 0$ and $H_{p_G} > 0$).[25] In that case, the increase in p_G would tend to increase the supply of exportables and the demand for labor in that sector. Consumption would therefore tend to increase to maintain external balance; to maintain market equilibrium, the real exchange rate would tend to appreciate and (at the initial level of labor supply in the informal sector) real wages in the informal sector would tend to increase. Because the net effect on skilled workers' wage and the demand for both categories of labor in the exportable sector is positive, and because the unskilled wage ratio falls, the net effect on the supply of unskilled labor in the formal economy—as can be inferred from (33)—is ambiguous.

Because movements in c and n_U^s are ambiguous in the long run, so are movements in wages, employment and unemployment of each category of labor. Under what conditions can a more precise characterization be obtained? As indicated earlier, the sensitivity of skilled workers' wage to changes in the real exchange rate (and thus to the size of the unskilled labor force seeking

[25]This would be the case if the union cares sufficiently about employment (so that ν is small) or if the sensitivity of informal sector output to wages is sufficiently large.

employment in the exportable sector) depends only on the degree of openness, δ. Suppose that δ is small (the case of a highly open economy), so that the sensitivity of ω_S to z is low. Because this assumption implies that $\Psi_{n_U^s}$ and H_c are small, it can be shown that, in this case:

$$sg\left[\frac{d\tilde{c}}{dp_G}\right] = sg(-\Psi_{p_G}), \quad sg\left[\frac{d\tilde{n}_U^s}{dp_G}\right] = sg(H_{p_G}).$$

Thus, because $\Psi_{p_G} > 0$ and $H_{p_G} < 0$ here, both consumption and labor supply in the formal economy fall. The real exchange rate depreciates ($\tilde{z}$ rises), implying from (20) that informal sector wages fall. Because the unskilled wage ratio, from (33) rises, unemployment of unskilled labor increases. Employment and output in the informal sector both increase. The product wage for skilled workers unambiguously falls and employment of both skilled and unskilled workers in the formal sector fall as well. The point, nevertheless, is that if indirect effects on skilled workers' wages are sufficiently strong, the increase in unemployment can be highly mitigated. Arguments against adjustment in the price of government services based on alleged adverse employment effects are therefore not necessarily valid once general equilibrium interactions are introduced in the analysis.

5.2 Transitional dynamics

Consider now the transitional effects of an increase in p_G, in the benchmark case in which δ is sufficiently small, and $\Psi_{p_G} > 0$ and $H_{p_G} < 0$. On impact, as shown in the Appendix, private consumption falls to reflect the long-run reduction in permanent income. From the equilibrium condition of the market for home goods (24), and because n_U^s cannot change instantaneously, the real exchange rate must depreciate. And from the informal labor market equilibrium condition (equation (20)), ω_N and z must move in opposite direction because n_U^s (and thus the supply of labor in the informal sector) is given; ω_N therefore falls. Output supply and employment in the informal

sector cannot change on impact. Thus, despite the fact that the real depreciation lowers the product wage of skilled workers in the exportable sector, the increase in p_G leads to a reduction in labor demand for both skilled and unskilled labor. Open unemployment therefore increases for both categories of workers. On impact, the current account moves into surplus (and foreign debt begins falling), because the reduction in output of exportables is less than the reduction in consumption.

A key feature of the adjustment path over time (which depends ion general on the parameters of the model) is that movements in foreign debt are non-monotonic. Over time, the reduction in the employment probability is such that it reduces expected income in the formal sector by more than the reduction in ω_N, ensuring that migration flows toward the informal sector are positive ($\dot{n}_U^s < 0$). During the first phase of the adjustment process, the current account remains in surplus and the economy's foreign debt continues to fall. Because the increase in the supply of labor in the informal sector continues to put downward pressure on wages there, and because the real exchange rate continues to depreciate (as a result of the fall in private consumption), the wage of skilled workers in the exportable sector continues to fall; and although initially this positive effect on output of exportables is outweighed by the increase in p_G, over time it tends to raise production in the exportable sector. However, the reduction in the stock of foreign debt during the first phase of the adjustment process tends to lower the risk premium, and thus the cost of borrowing—leading agents to increase consumption. Because this increase in private spending tends to exceed the rise in output of exportables, the trade and current account surpluses begin falling. During the second phase of adjustment the current account turns into deficit. The stock of debt starts to increase (with labor supply in the formal sector continuing to fall) and continues to do so until the economy reaches its new long-run equilibrium position—characterized by the same level of foreign debt as in

the original steady state.

6 Summary and Conclusions

The role of the labor market in the process of economic adjustment in developing countries has been the subject of renewed interest in recent years. The purpose of this paper has been to study the effects of fiscal adjustment policies in a macroeconomic framework that captures some of the most salient features of these markets. The model developed here captures, in particular, the existence of a large informal sector producing nontraded goods, and the use of public intermediate inputs in the production of tradables. Labor market segmentation was introduced through minimum wage legislation for unskilled labor. Wages earned by skilled workers in the exportable sector were assumed to be determined by a utility-maximizing trade union. Despite wage flexibility in the informal sector, "quasi-voluntary" unemployment of both skilled and unskilled workers was shown to typically emerge in equilibrium. Skilled unemployment emerges as a result of the assumption that the opportunity cost of leisure is lower and/or the reservation wage is higher than the going wage in the informal sector, whereas unskilled unemployment results from "wait" or "queuing" considerations in the tradition of Harris and Todaro (1970).

The model was used to study the wage and employment effects of an increase in the price of government services. The analysis showed first that the stock of foreign debt is invariant to such a shock. Second, it was shown that the net effect on consumption and labor supply in the formal economy is ambiguous. The increase in the price of government services, by lowering the demand for unskilled labor in the exportable sector, tends to reduce the overall supply of labor in the formal sector. This, however, raises the number of job seekers in the informal economy, which in turn tends to lower wages there and thus to raise supply of informal sector goods. To maintain

equilibrium of the market in informal sector goods, the real exchange rate must therefore depreciate. This depreciation puts downward pressure on the wage demanded by the union. The effect on the product wage for skilled workers, the net effect on the demand for that category of labor, and thus output of exportables, are ambiguous; and because private consumption must move in the same direction as output of exportables to maintain current account equilibrium, the movement in c is ambiguous as well.

If the economy is highly open, and if the net effect of an increase in the price of government services on the demand for unskilled workers and the supply of exportables are both negative (the "benchmark" case), both consumption and labor supply in the formal economy fall. The real exchange rate depreciates and informal sector wages fall. Because the unskilled wage ratio (the minimum wage divided by the informal sector wage) rises, unemployment of unskilled labor increases. Employment and output in the informal sector increase as well.

On impact, in the benchmark case, consumption falls to reflect the long-run reduction in permanent income. The reduction in private spending is larger than the reduction in output of exportables, so that the current account moves into surplus. The real exchange rate depreciates and wages in the informal sector fall in such a way that the product wage there remains constant. Output supply and employment in the informal sector therefore cannot change on impact. The reduction in labor demand for both skilled and unskilled labor means that open unemployment increases for both categories of labor. During the first phase of the transition, the current account remains in surplus and the stock of foreign debt falls; the supply of unskilled labor in the formal sector also falls—as a result of the reduction in the demand for unskilled workers in that sector and the initial deterioration of employment prospects. In the second phase of the transition, the downward movement in informal sector wages (which does not dominate the reduction in expected

income in the formal sector, so that the number of job seekers in that sector continues to fall) leads to a depreciation of the real exchange rate and a reduction in the product wage of skilled workers in the exportable sector. This stimulates output of exportables. However, at the same time, the reduction in the risk premium on foreign borrowing induced by the reduction in the stock of debt in the first phase raises consumption, sufficiently so to ensure that the current account moves into deficit and the stock of external debt begins to rise—until the new long-run equilibrium is reached, with the level of foreign debt equal to the initial level.

The analysis developed in this paper could be extended in a variety of ways, by considering for instance the case in which government services are also used as intermediate inputs in the production process in the informal sector. In this case, output of informal sector goods would also fall on impact following an increase in the price of government services, rather than remaining unchanged; otherwise, however, the effects of this shock would remain qualitatively similar to those described earlier. Perhaps a more fruitful extension would be to introduce distortionary taxation, and to assume that informal sector activities are taxed at a lower rate (possibly zero) than those performed in the formal sector. Because, as shown earlier, fiscal adjustment policies typically lead to a reallocation of production activities and employment across sectors in the long run, they also affect tax revenue. Such changes in revenue may have important implications for alternative sources of deficit financing, notably the degree of reliance on the inflation tax. Extensions of this type, together with detailed empirical work on labor demand elasticities, the degree of labor mobility and the degree of relative wage rigidity across sectors, are essential for improving further our understanding of the aggregate effects of adjustment programs on wages and employment.

Appendix
Stability Conditions

Equations (28), (29) and (30) form a dynamic system in c_S, n_U^s and D^* which can be linearized around the steady state to give

$$\begin{bmatrix} \dot{c} \\ \dot{n}_U^s \\ \dot{D}^* \end{bmatrix} = \begin{bmatrix} 0 & 0 & G' \\ \beta H_c & \beta H_{n_U^s} & 0 \\ \Psi_c & \Psi_{n_U^s} & \Psi_{D^*} \end{bmatrix} \begin{bmatrix} c - \tilde{c} \\ n_U^s - \tilde{n}_U^s \\ D^* - \tilde{D}^* \end{bmatrix}. \tag{A1}$$

Saddlepath stability requires one unstable (positive) root. Necessary and sufficient conditions are thus that the determinant of the matrix of coefficients $\mathbf{A}$ in (A1) be positive (which excludes one or three negative roots) and that its trace be negative (which guarantees at least one negative root):

$$\mathrm{tr}\mathbf{A} = \beta H_{n_U^s} + \Psi_{D^*} < 0,$$

$$\det \mathbf{A} = G'\beta(H_c \Psi_{n_U^s} - \Psi_c H_{n_U^s}) > 0.$$

A sufficient condition for $\mathrm{tr}\mathbf{A} < \mathbf{0}$ is that the speed of adjustment, β, is sufficiently large. The condition on $\det \mathbf{A}$ requires $H_c/H_{n_U^s} > \Psi_c/\Psi_{n_U^s}$.

To solve for the initial jump in c and examine graphically the transitional dynamics associated with a reduction in ω_G and p_G, we use the technique suggested by Dixit (1980). As shown by Dixit, if the system evolves along the stable manifold, it must be the case that, at each point in time:

$$c - \tilde{c} = -h_{13}^{-1} h_{23}(n_U^s - \tilde{n}_U^s) - h_{13}^{-1}(D^* - \tilde{D}^*), \tag{A2}$$

where h_{13} and h_{23} are elements of the (appropriately normalized) left eigenvector of $\mathbf{A}$ corresponding to the positive characteristic root ν_3. Thus, h_{13} and h_{23} satisfy the following equation:

$$[h_{13} \quad h_{23} \quad 1][-\mathbf{A} + \nu_3 \mathbf{I}] = [0 \quad 0 \quad 0]. \tag{A3}$$

This equation can be solved for h_{13} and h_{23} as functions of ν_3. With Ψ_{D^*} sufficiently small, we have

$$h_{13} = (\nu_3 - \Psi_{D^*})/G', \quad h_{23} = \frac{\Psi_{n_U^s}}{\nu_3 - \beta H_{n_U^s}} > 0, \tag{A4}$$

where h_{13} is in general ambiguous. It will be assumed in what follows that $h_{13} < 0$, a condition which requires that the elasticity of the risk premium with respect to the level of debt be sufficiently large.[26]

From equation (A2), the impact effect of an unanticipated permanent reduction in p_G on consumption is given by, because $dn_U^s(0)/dp_G = dD_0^*/dp_G = 0$:

$$\frac{dc_0}{dp_G} = \frac{d\tilde{c}}{dp_G} + h_{13}^{-1}h_{23}(\frac{d\tilde{n}_U^s}{dp_G}) + h_{13}^{-1}(\frac{d\tilde{D}^*}{dp_G}).$$

From equation (30) with $\dot{n}_U^s = 0$, we have

$$\frac{d\tilde{n}_U^s}{dp_G} = -(\frac{H_c}{H_{n_U^s}})(\frac{d\tilde{c}}{dp_G}) - \frac{H_{p_G}}{H_{n_U^s}}.$$

Substituting this result in the previous expression yields

$$\frac{dc_0}{dp_G} = (1 - h_{13}^{-1}h_{23}\frac{H_c}{H_{n_U^s}})\frac{d\tilde{c}}{dp_G} + h_{13}^{-1}\frac{d\tilde{D}^*}{dp_G} - h_{13}^{-1}h_{23}(\frac{H_{p_G}}{H_{n_U^s}}),$$

where, given that $h_{13} < 0$, the expression in parentheses on the left-hand side (denoted Θ in what follows) is positive, and $h_{13}^{-1}h_{23}(H_{p_G}/H_{n_U^s}) < 0$. As discussed in the text,

$$d\tilde{D}^*/dp_G = 0.$$

In the benchmark case in which δ is sufficiently small, and $\Psi_{p_G} > 0$ and $H_{p_G} < 0$,

$$d\tilde{c}/dp_G < 0.$$

Thus

$$\frac{dc_0}{dp_G} = \Theta\frac{d\tilde{c}}{dp_G} - h_{13}^{-1}h_{23}\frac{H_{p_G}}{H_{n_U^s}},$$

which implies that, with $\Psi_{n_U^s}$ small and thus h_{23} small:

$$dc_0/dp_G < 0.$$

[26]For $h_{13} < 0$ requires $\Psi_{D^*} > \nu_3$. From the definition of $\Psi_{D^*} = i_f^* + \kappa + \kappa'\tilde{D}^*$, this expression can be written as $(i_f^*/\kappa)+1+\eta_{\kappa/D^*} > \nu_3$, or equivalently, $\eta_{\kappa/D^*} > \nu_3 - 1 - i_f^*/\kappa$, where η_{κ/D^*} is the elasticity of the premium with respect to the level of foreign debt.

Thus, consumption also falls on impact in the benchmark case.

To examine the transitional dynamics of n_U^s and D^*, equation (A2) can be used to reduce the system (A1) to only two differential equations:

$$\begin{bmatrix} \dot{n}_U^s \\ \dot{D}^* \end{bmatrix} = \begin{bmatrix} \beta(H_{n_U^s} - H_c h_{13}^{-1} h_{23}) & -\beta H_c h_{13}^{-1} \\ \Phi & \Psi_{D^*} - \Psi_c h_{13}^{-1} \end{bmatrix} \begin{bmatrix} n_U^s - \tilde{n}_U^s \\ D^* - \tilde{D}^* \end{bmatrix}, \tag{A5}$$

where $\Phi = \Psi_{n_U^s} - \Psi_c h_{13}^{-1} h_{23}$.

In the matrix of coefficients, $\beta(H_{n_U^s} - H_c h_{13}^{-1} h_{23})$ and $-H_c h_{13}^{-1}$ are both negative, and $\Psi_{D^*} - \Psi_c h_{13}^{-1}$ is positive, because $h_{13} < 0$. Φ is in general ambiguous in sign–even in the benchmark case in which $\Psi_{n_U^s}$ (and thus h_{23}) is small.

Let $\mathbf{M}$ denote the coefficients matrix in system (A5). Necessary and sufficient conditions to ensure local stability of the system (that is, that the system's two characteristic roots have negative real parts) are

$$tr\mathbf{M} = \boldsymbol{\beta}(H_{n_U^s} - H_c h_{13}^{-1} h_{23}) + (\Psi_{D^*} - \Psi_c h_{13}^{-1}) < 0,$$

$$\det \mathbf{M} = \beta[(H_{n_U^s} - H_c h_{13}^{-1} h_{23})(\Psi_{D^*} - \Psi_c h_{13}^{-1}) + \Phi H_c h_{13}^{-1}] > 0.$$

The first condition is satisfied if the speed of adjustment, β, is sufficiently large. The second condition depends on whether Φ is positive or negative. If Φ is negative, the above condition on $\det \mathbf{M}$ always holds. If Φ is positive, for $\det \mathbf{M} > 0$ requires that the slope of DD in Figure 2 be steeper than the slope of LL. From the definitions given above, for $\Phi > 0$ it must be that

$$\frac{\Psi_c G'}{(\nu_3 - \beta H_{n_U^s})(\nu_3 - \Psi_{D^*})} < 1,$$

which can be shown to hold if β is sufficiently large.

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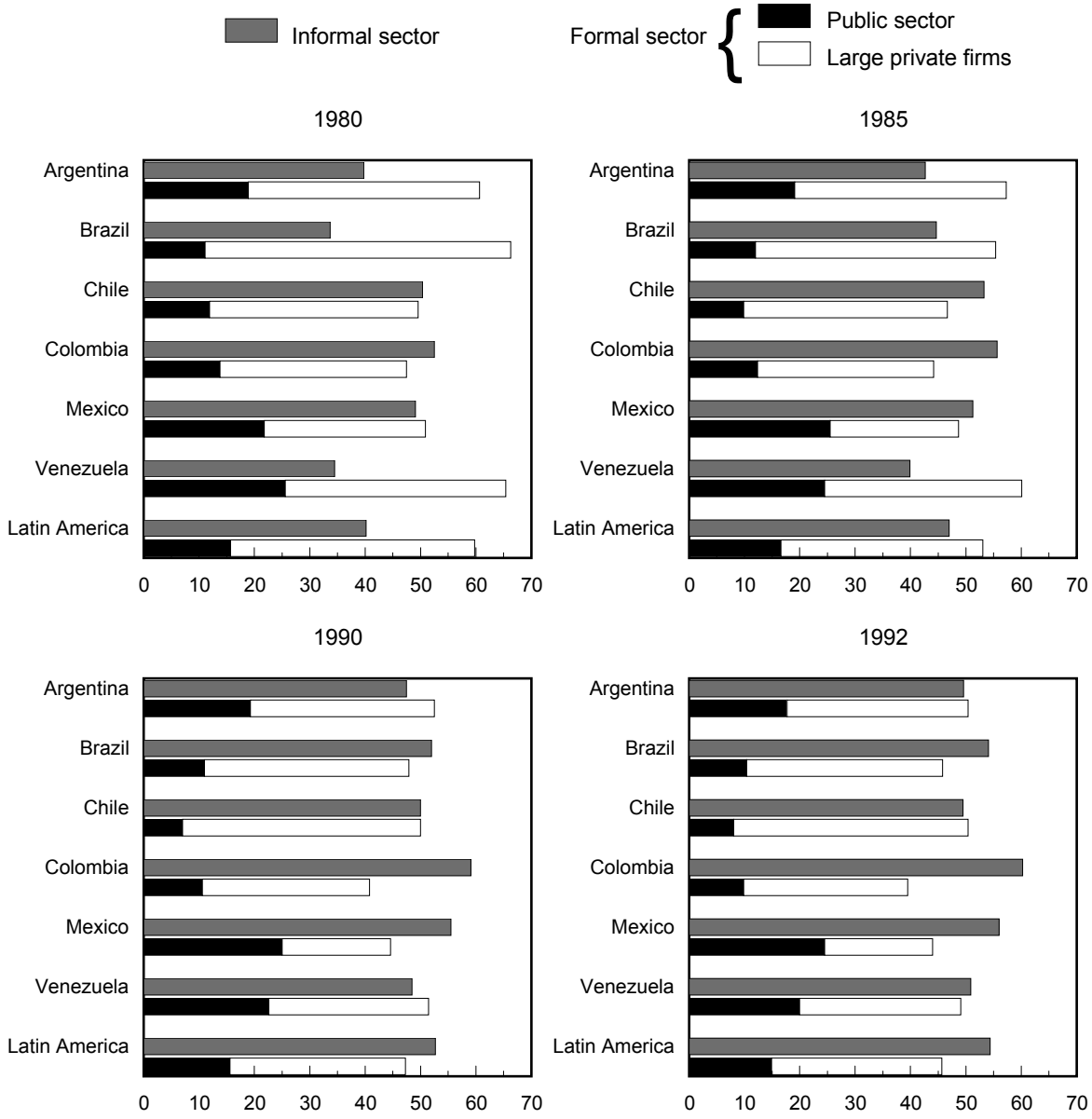
Figure 1
Latin America: Composition of Nonagricultural Employment



Source: Thomas (1996).

Figure 2
Steady-State Equilibrium in the condensed System

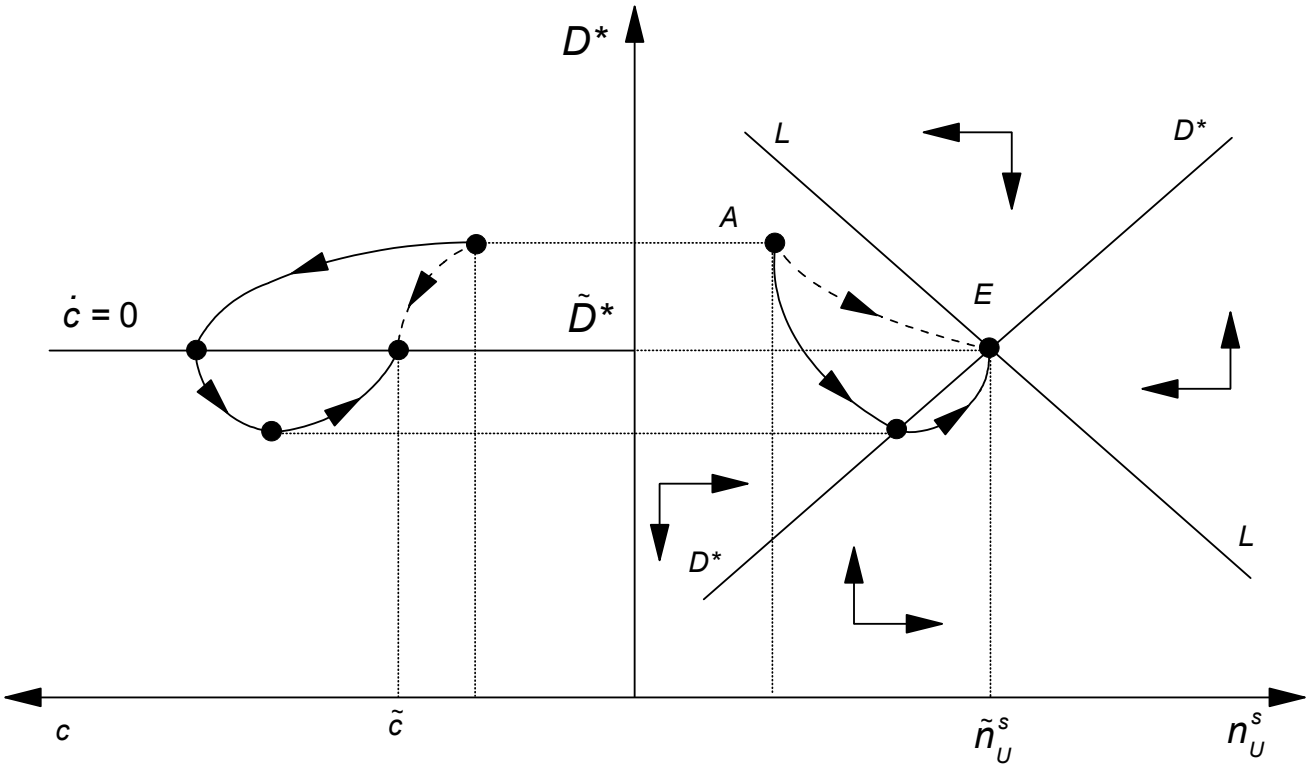


Figure 3

Labor Market Equilibrium and Unemployment