UNEMPLOYMENT-POVERTY TRADEOFFS

Pierre-Richard Agénor
World Bank

Reducing unemployment and alleviating poverty are key policy goals in many developing countries, yet progress remains elusive on both fronts. Although the measurement of poverty and the use of international poverty lines for cross-country comparisons have generated much controversy in recent years (see Deaton, 2001, 2003; Ravallion, 2003), there is some agreement that poverty remains high in many parts of the world and has even increased in some countries. Figure 1 displays the behavior of the headcount ratio, which measures the incidence of poverty (that is, the proportion of individuals or households earning less than a given level of income), in various regions of the developing world, using international poverty lines of $1.08 and $2.16 a day.[1] World Bank data show that between 1990 and 1999, poverty rates fell significantly in East Asia and the Pacific, but they increased in Europe, Central Asia, the Middle East, and North Africa, while countries in Latin America and the Caribbean, South Asia, and Sub-Saharan Africa recorded very little progress. According to the United Nations, poverty rates (measured by the proportion of a country's people living below $1.08 a day) increased in the 1990s in thirty-seven out of sixty-seven countries for which data were available (UNDP, 2003).[2] Projections for 2015 based on

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1. Let y^* be the poverty line; the headcount ratio is defined as $PH = n/N$, where n is the number of households below the poverty line and N is the total number of households.

2. Fifty-four countries also recorded an average growth rate below zero for the last decade, and twenty-one countries experienced a drop in the human development index (a more comprehensive measure of welfare calculated by the United Nations, which includes life expectancy and literacy). Twelve countries registered a decline in primary school enrollment rates, and fourteen countries recorded an increase in child mortality.

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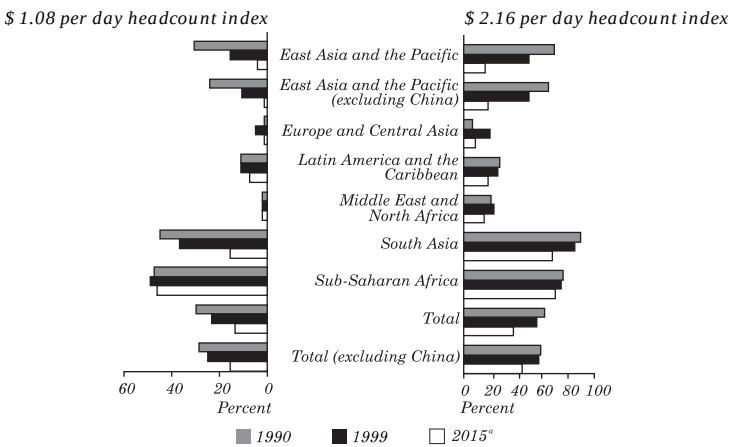
current trends indicate that prospects remain bleak for Sub-Saharan Africa.

Unemployment has also become a great source of concern. Women and the young have been particularly hard hit, because their jobs are highly vulnerable to adverse economic shocks. The International Labor Organization (ILO) estimates that the number of unemployed workers worldwide grew by 20 million between the beginning of 2001 and the end of 2002, to reach a record level of 180 million (ILO, 2003). As shown in figure 2, only in transition economies did unemployment rates fall in recent years. They remain well above 10 percent in several countries—and are even close to 20 percent in Bulgaria, Poland, the Slovak Republic, and the former Yugoslavia—despite strong economic growth in recent years.[3] In Latin America, many countries (including those with sustained growth) have experienced major increases in unemployment: the unemployment rate doubled to more than 10 percent in Argentina and Brazil in the 1990s. In the Middle East and North Africa, the population nearly quadrupled during the second half of the past century, and employment growth failed to keep pace with the resulting expansion of the labor force in the 1980s and 1990s.

Figure 1. Poverty Headcount Index, 1990–2015



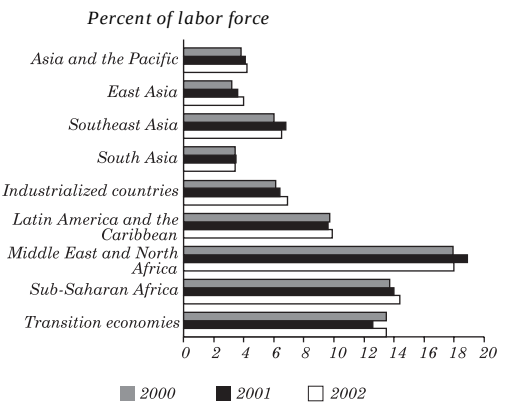
Source: World Bank.
a. Projections.

3. Unemployment was nonexistent at the beginning of the 1990s in Central and Eastern Europe, but it jumped to about 15 percent of the labor force in the early phases of the transition to a market economy.

Consequently, the Middle East and North Africa recorded some of the highest unemployment rates among developing regions in the 1990s. According to the ILO, unemployment rates range from less than 3 percent in the United Arab Emirates to close to 30 percent in Algeria. In 2001, the number of unemployed in the region—mostly the young (or first-time job seekers) and women—was estimated to be over 22 million, or 17.6 percent of the labor force.[4] Based on current trends, prospects remain bleak. The United Nations estimates that the population in the Middle East and North Africa is likely to continue to grow faster than in any other region between 2000 and 2015; the labor force is expected to grow at a rate of about 3 percent, such that unemployment could exceed 25 million by the year 2010 (UNDP, 2002).

Unemployment reduction and poverty alleviation are often viewed as complementary policy goals that involve no tradeoffs. This is not always the case, however. The experience of recent years shows that vulnerable groups (namely, young people, older workers, women, and the unskilled) frequently benefited little from improvements in aggregate macroeconomic conditions, and they often ended up in poorly paid jobs. In Latin America, the share of the so-called working poor (that is, workers who earn less than the $1.08 a day international poverty line) in total employment rose significantly in many countries.

Figure 2. Unemployment Rates by Region, 2000–02



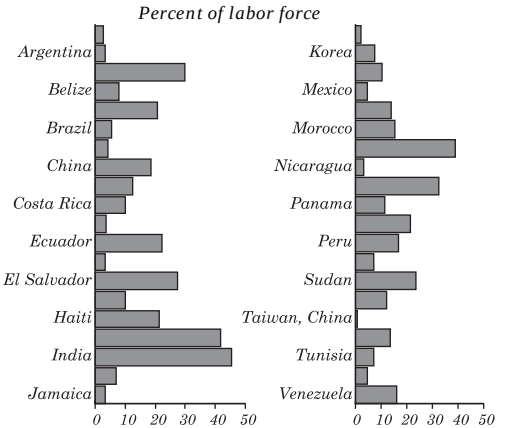
Source: International Labor Organization.

4. In Egypt, for instance, the unemployment rate for women (22.6 percent) is four times that of men, and in Jordan it is almost double. The youth unemployment rate is almost 39 percent in Algeria and exceeds 73 percent in Syria (ILO, 2003). The World Bank (2004) reports a regional unemployment rate of 14.9 percent for 2000–01, with 20 million unemployed.

In Sub-Saharan Africa and South Asia, measured unemployment remains relatively low, yet the share of the working poor in total employment averaged almost 40 percent in both regions, reaching 50 percent in India (ILO, 2003) (see figure 3). In the Middle East and North Africa, the proportion of working poor is also high, as is the case, for instance, in Morocco and Syria. A potential tradeoff between unemployment reduction and poverty alleviation is thus readily apparent: to the extent that the increased growth rates of output and job creation that are needed to absorb the increased labor supply and reduce unemployment require a significant drop in real wages, the deterioration in living standards may lead to a rise in poverty.

Various other sources of potential tradeoffs between reducing poverty and lowering unemployment may arise in both the short and the long term. This paper provides a systematic assessment of the factors that may entail an arbitrage between these two key policy goals. Section 1 presents a broad analytical discussion of the conditions that may trigger unemployment-poverty tradeoffs, focusing in particular on the role of labor market reforms such as a cut in payroll taxes on unskilled labor, a reduction in the minimum wage, and a reduction in firing costs. Section 2 proposes two econometric techniques for empirically assessing the importance of unemployment-poverty tradeoffs. The first is based on a vector autoregression (VAR) model linking the cyclical components of output, real wages, unemployment, and poverty.

Figure 3. Proportion of Working Poor[a]



Source: International Labor Organization.
a. The working poor are workers who do not earn enough to lift themselves and their families above the US$1.08-a-day poverty line.

The second involves cross-country regressions of the determinants of poverty rates, with the unemployment rate among the explanatory variables. Section 3 proposes a third approach, based on a simulation model that integrates a structural macroeconomic component and a household survey to assess the impact of policy shocks on unemployment and poverty. The analysis focuses on labor market reforms as a source of shocks and studies their impact on the composition of both unemployment (skilled and unskilled) and poverty (with a distinction between various categories of urban households). Many economists regard labor market rigidities as being a major obstacle to an expansion of employment in the formal economy and a reduction of urban poverty, which tends to be concentrated in the informal sector.[5] At the same time, the possible existence of tradeoffs between unemployment and poverty reduction has received scant attention in the analytical literature focusing on these reforms. The framework presented in this paper is particularly useful because it allows a description of the transitional dynamics induced by policy shocks. It is therefore possible to assess not only whether such shocks entail the existence of a short-term tradeoff between unemployment and poverty reduction, but also whether this tradeoff tends to persist over time. The last part of the paper offers some concluding remarks and identifies some research perspectives.

1. Sources of Tradeoffs

At the level of an individual country, a tradeoff between poverty and unemployment can surface either at the aggregate (economy-wide) level or at the level of individual household groups (for instance, urban households). Tradeoffs at both levels may entail a temporal dimension, in the sense that they may emerge in the short term but vanish in the long run (or vice versa). This section analyzes the conditions under which aggregate and partial tradeoffs between unemployment and poverty may arise. It also draws the implications of the analysis for predicting and interpreting the correlation between these two variables across countries.

As noted earlier, an obvious reason for an inverse correlation (or the lack thereof) between poverty and unemployment is based on the possibility that reducing unemployment requires a fall in real wages;

5. See, for instance, Saavedra (2003) for a review of the Latin American experience with labor market reform in the 1990s.

this lowers real income and therefore leads to an increase in poverty. The tradeoff may be particularly steep if the expansion in employment (induced by lower real wages and output growth) is skewed toward low-paying jobs. The increase in the number of working poor appears consistent with this interpretation, although the concomitant increase in unemployment observed in some countries would suggest that real wages did not fall sufficiently or that the labor supply expanded simultaneously. Put differently, an increase in the number of working poor induced by lower wages does not necessarily imply an inverse correlation between poverty and unemployment; it depends on the magnitude of the fall in wages and on the strength of the "encouragement effect" associated with higher growth and employment on participation rates.

This discussion suggests, however, that unemployment and poverty are jointly endogenous—and if unemployment and poverty are simultaneously determined, the correlation between them will be driven by factors that are likely to vary over time or across countries, depending on the sources of shocks that prove to be dominant. Although adverse wage shocks may be an important source of negative correlation between unemployment and poverty over time (and across countries or regions), other sources of shocks to labor demand may also matter. In general, if the economy's aggregate production function is not separable in (all) inputs, the demand for labor will depend not only on the cost of labor, but also on all the variables other than labor affecting output, including overall productivity and inputs such as physical capital and imported raw materials. Productivity shocks, in particular, may also affect the unemployment-poverty correlation, either positively or negatively. A positive productivity shock, for instance, may raise labor demand and put upward pressure on wages, thereby lowering both unemployment and poverty (if the increase in the wage rate is suñfficient to raise it above the poverty line). But if wages cannot adjust as a result, say, of a binding minimum wage, then the number of working poor may rise. In that case, although unemployment may fall, overall poverty rates may increase if the minimum wage is below the poverty line.

The underlying source of these shocks (whether to wages or productivity) may be policy induced, rather than the result of purely random disturbances. Consequently, changes in real wages and productivity may themselves be endogenous and may need to be analyzed jointly with changes in poverty and unemployment. Policies aimed at improving labor market flexibility, for instance, may indeed

entail a tradeoff between unemployment and poverty, through their impact on wages and labor demand. Labor market regulations, particularly job security provisions, have been shown to have a major impact on both the level and distribution of employment in many developing countries.[6] An increase in employment subsidies, for instance, may have a direct, beneficial impact on unskilled employment; at the same time, it may increase poverty if it is financed by an increase in the sales tax on goods sold domestically, because of the impact of the tax hike on the cost of living. Thus, although the subsidy may increase the nominal (and product) wage of the unskilled, their real (consumption) wage may fall. The impact may be particularly large for the poorest households in urban areas, depending on the exact nature of the tax that is used to offset the impact of the increase in spending on the budget (whether it is indeed an increase in the sales tax or a rise in income tax on individuals or firms) and on the composition of household spending. It is possible for poverty to increase in the informal sector (because workers in that sector bear the brunt of the increase in consumer prices, for instance), while at the same time unskilled unemployment falls in the formal economy.

A reduction in the payroll tax on unskilled labor (a policy that is often advocated to reduce unemployment) may have similar results. If the reduction in the payroll tax is financed by a mixture of higher taxes on domestic goods and corporate income, and if the reduction in the net rate of return on physical capital accumulation lowers investment incentives, then the net effect on employment may be mitigated. The demand for labor may not increase over time as much as it would otherwise because of the gross complementarity between capital and labor. Unemployment may thus fall to a limited extent, whereas poverty among the most vulnerable urban groups may increase significantly—again, because higher taxes on domestic goods have a large impact on the cost of living faced by that category households.

Even labor market reforms that do not have a direct impact on the government budget may entail a tradeoff between unemployment and poverty, as a result of their indirect, general equilibrium effects. A cut in the minimum wage, for instance, may indeed increase the demand for unskilled labor in the urban formal sector; poverty may increase, however, if the cut is large and the elasticity of demand for that category of labor is not high. To the extent that the cut in the

6. See Heckman and Pagés (2000) and Saavedra (2003) for the case of Latin America.

minimum wage reduces the expected wage (because the employment ratio does not rise sufficiently to offset the reduction in labor income), it may also lower the incentive to queue for employment in the formal economy. Consequently, the supply of labor in the informal sector may increase, thereby putting downward pressure on wages there. Urban poverty rates may therefore increase, although in general the effect is ambiguous.[7]

In a growth context, an ambiguous correlation between unemployment and poverty may also emerge from the combination of an inverse correlation between growth and poverty (a sufficient condition for which is a distribution-neutral growth process) and an ambiguous relationship between growth and unemployment, depending on the source of the underlying shock. The source of ambiguity is well illustrated in a simplified version of the model developed by Bean and Pissarides (1993), which considers a two-period economy with overlapping generations and a constant population.[8] Suppose that production in each individual firm in this economy, Y_t, exhibits constant returns to scale in the firm's capital, K_t, and diminishing returns to labor:

$$Y_t = K_t n_t^{\alpha} , \tag{1}$$

where $0 < \alpha < 1$ and

$$n_t = \frac{\bar{K}_t N_t}{K_t} ,$$

with N_t denoting the firm's employment level and $\bar{K}_t$ the economy-wide stock of capital (which is treated as given by individual firms). Capital depreciates fully in a single period. Technology thus exhibits positive externalities, in Romer-like fashion.

Potential workers and employers have to search for each other, with the number of successful matches increasing in both the number of unemployed and the number of job vacancies. This matching process takes place at the start of the period, and individuals who fail to find a job then have no chance to reenter the labor market later. Given the generational structure, this implies that all matches last

7. The transmission process of a cut in the minimum wage is studied more formally in the context of the structural model described later.

8. The simplifications involve abstracting from intertemporal considerations in household decisions and choosing a specific functional form for the production technology.

exactly one period. The matching technology for aggregate employment, $\bar{N}_t$, may thus be written as

$$\bar{N}_t = m\left(\bar{V}_t, L_t\right), \tag{2}$$

where $\bar{V}_t$, is the aggregate number of job openings at the start of period t and L_t is the number of young households. The matching function is concave, homogeneous of degree one, and increasing in both arguments.[9] These properties can be summarized by the following restrictions:

$$m_i > 0, \;\; m_{ii} < 0, \;\; m\left(0, L_t\right) = m\left(\bar{V}_t, 0\right) = 0 \;,$$

$$\lim_{\bar{V}_t \to \infty} m\left(\bar{V}_t, L_t\right) = L_t \;, \text{ and } \lim_{L_t \to \infty} m\left(\bar{V}_t, L_t\right) = \bar{V}_t \;.$$

Because the population is constant, one can set L_t = 1 and suppress it in what follows, so that

$$m\left(\bar{V}_t, 1\right) = m\left(\bar{V}_t\right).$$

Thus, $\bar{N}_t$(or, respectively, $\bar{N}_t - 1$) can be interpreted as the economy-wide employment (or unemployment) rate.

Hires by an individual firm, N_t, are proportional to the number of vacancies it has relative to the aggregate, that is,

$$N_t = \left(\frac{V_t}{\bar{V}_t}\right) m\left(\bar{V}_t\right). \tag{3}$$

Households are endowed with one unit of labor, which is supplied inelastically in the first period of life. Their propensity to save when young is assumed constant and equal to $0 < \gamma < 1$. In the second period of their lives, households become entrepreneurs and invest directly. A firm's profits, Π_t, are given by

$$\Pi_t = K_t n_t^{\alpha} - w_t N_t - q_t V \;, \tag{4}$$

9. Concavity is assumed in order to capture a congestion externality in the labor market. The higher the number of vacancies opened by firms, the shorter is the search effort of unemployed workers; and the more unemployed workers searching for jobs in the labor market, the faster is the match available for each firm.

where w_t is the wage rate and q_t is the hiring cost per job opening, which is assumed to be proportional to the economy-wide capital stock, $\bar{K}_t$:[10]

$$q_t = \chi \bar{K}_t . \tag{5}$$

The wage is determined after a match has occurred, as the outcome of a Nash bargain between the firm and the individual worker. Workers can only work at one firm, and if both parties fail to reach agreement, neither has the opportunity to look for an alternative match elsewhere.[11] The firm's utility is linear in the marginal profit from employing an additional worker, that is, using equation (1),

$$\alpha \bar{K}_t n_t^{\alpha-1} - w_t .$$

Thus, using the wage rate as a measure of the worker's surplus, and assuming that the unemployed receive no benefit and have no alternative source of income, the wage must satisfy

$$w_t = \text{Arg max}\, w_t^{\beta} \left(\alpha \bar{K}_t n_t^{\alpha-1} - w_t \right)^{1-\beta} ,$$

where $0 < \beta < 1$ measures the worker's bargaining strength. This equation yields the first-order condition

$$\beta w_t^{-1} \left(\alpha \bar{K}_t n_t^{\alpha-1} - w_t \right) - (1-\beta) = 0 ,$$

from which the equilibrium wage can be derived as

$$w_t = \alpha \beta n_t^{\alpha-1} \bar{K}_t . \tag{6}$$

10. In this setting only firms incur a cost to match workers with their opened vacancies; workers passively wait for a match, comparing their prospective income with the opportunity cost of being unemployed. An alternative approach, following King and Welling (1995), would be to assume that workers bear a direct cost when they decide to actively search for a job. This assumption would be more appropriate for developing economies, where the lack of adequate institutions in the labor market may create informational frictions.

11. This assumption can be relaxed (by assuming instead that it is costly for each agent to change an alternative match) without affecting qualitatively the main results of the model.

Substituting equation (6) into equation (4) and eliminating V_t using equations (2) and (3), together with equations (1) and (5), yields

$$\Pi_t = K_t \left\{ n_t^{\alpha} - \left[\alpha\beta n_t^{\alpha-1} + \chi \frac{m^{-1}\left(\bar{N}_t\right)}{\bar{N}_t} \right] n_t \right\} = K_t \left[\left(1-\alpha\beta\right) n_t^{\alpha} - \chi \frac{m^{-1}\left(\bar{N}_t\right)}{\bar{N}_t} n_t \right].$$

The firm's optimal choice of n_t thus satisfies

$$\frac{d\Pi_t}{dn_t} = \alpha\left(1-\alpha\beta\right) n_t^{\alpha-1} - \chi \frac{m^{-1}\left(\bar{N}_t\right)}{\bar{N}_t} = 0 \ .$$

With a large number of identical firms, and in general equilibrium, $K_t = \bar{K}_t$, $N_t = \bar{N}_t$, and $n_t = N_t$. The above expression thus becomes

$$\alpha N_t^{\alpha-1} = \frac{\chi}{1-\alpha\beta} \frac{m^{-1}\left(N_t\right)}{N_t} \ , \tag{7}$$

which equates the marginal product of labor to an expression that captures both the marginal cost of matching capital and labor and the strategic use of employment by the firm to affect the outcome of the wage bargain (high employment lowers the marginal product and thus also the wage).

Finally, the evolution of the capital stock is determined by the savings of the young, that is, given the assumption of a full depreciation of capital, $K_{t+1} = \gamma w_t N_t$. Using equation (6) with $K_t = \bar{K}_t$ and $N_t = \bar{N}_t$ yields

$$\frac{K_{t+1}}{K_t} = \gamma\alpha\beta N_t^{\alpha} \ . \tag{8}$$

The growth rate of output (or, equivalently here, output per capita) along a balanced growth path with a constant employment rate is $K_{t+1}/K_t - 1$, which is obtained from equation (8). Thus, equations (7) and (8) determine the economy's equilibrium in terms of the employment rate and the growth rate of output.

This framework can be used to analyze the impact of various changes in the parameters along balanced growth paths.[12] A reduction in hiring costs, χ, raises employment, the rate of capital formation, and growth. An increase in the propensity to consume (a reduction in γ) lowers the growth rate but has no effect on employment. The first experiment predicts a negative empirical (cross-sectional) relation between growth and unemployment—and thus a positive relation between the latter variable and poverty—if differences in growth rates are primarily due to differences in hiring costs across countries. By contrast, no systematic relation should be observed if cross-country differences result from differences in saving rates.[13]

An increase in the relative bargaining strength of workers, β, has two opposite effects. On the one hand, from equation (7), it tends to reduce employment and the growth rate, under reasonable conditions.[14] On the other, it tends to increase the growth rate, with no effect on employment. The effect on growth is thus ambiguous. Intuitively, these two effects can be explained as follows. On the one hand, the increase in bargaining strength shifts income from entrepreneurs (who consume all their income here) to workers, which raises savings and fosters growth. On the other, provided that the strategic effect is not too strong, unemployment rises, thereby reducing workers' income and the available pool of savings and dampening growth. The overall impact on growth (and thus poverty) depends on which effect dominates.

The recent growth literature features several other models that may lead to a negative correlation between unemployment and poverty, as a

12. Exercises of this type are complicated, in general, because changes in parameters will generally affect the rate of return and thus the propensity to save. However, these changes are simpler to analyze here because of the assumption of a constant saving rate.

13. In the present framework, an exogenous reduction in the saving rate has the conventional classical effect of lowering investment and reducing the growth rate. Bean and Pissarides (1993) develop a two-sector extension of this model based on imperfect competition in the consumption goods sector, which implies (in the Keynesian tradition) that an increase in the propensity to consume raises both investment and growth.

14. This is most easily shown if the matching technology involves constant elasticity of substitution (CES), that is,

$$\bar{N}_t = \left(\bar{V}_t^{-\rho} + L_t^{-\rho}\right)^{-1/\rho},$$

with $\rho > 0$. The resulting equation (7) may yield multiple solutions, but the implicit function theorem can be used to show that an increase in β does reduce employment.

result of a nonlinear relation between unemployment and growth. These models include Aghion and Howitt (1994), Cahuc and Michel (1996), van Schaik and de Groot (1995), and Aricó (2003). In the Aghion-Howitt framework, for instance, an increase in the growth rate of productivity raises the present discounted value of the profits from opening a new job, which leads firms to open more vacancies and thus reduces unemployment. This is what they call a capitalization effect. At the same time, when productivity growth occurs through the creative destruction of low-productivity jobs and their replacement by new high-productivity ones elsewhere in the economy, then the inflow rate into unemployment will also be increased. This is termed the reallocation effect, which affects workers in the opposite direction of the capitalization effect. Aghion and Howitt show that the reallocation effect dominates at low growth rates, whereas the capitalization effect dominates at high ones, leading to a hump-shaped relation between growth and unemployment. Although the foregoing analysis is based on a causal effect from growth to unemployment (instead of the presumption that growth and unemployment are jointly determined, as emphasized by Bean and Pissarides, 1993), its main point is similar to the one made earlier: tradeoffs between unemployment and poverty reduction may emerge as a result of policy or structural shocks.

In practice, labor is heterogeneous, and households differ in terms of their sources of income. This implies that any analysis of unemployment must take into account its composition; similarly, changes in poverty rates must be examined not only at the aggregate level, but also at the level of various household groups. A policy-induced shock may entail a tradeoff solely between unemployment of one category of workers (say, unskilled workers) and one particular group of households (say, households in the urban informal sector). Consider, for instance, a reduction in the minimum wage, as discussed earlier; to the extent that the wage cut leads formal sector firms to substitute away from skilled labor (which has a higher degree of complementary with physical capital than with unskilled labor), skilled unemployment may increase at the same time that unskilled unemployment falls. In such conditions, the nature of the social welfare function becomes crucial in choosing a given policy path. The simulation framework presented below will help to illustrate partial tradeoffs of this nature.

2. Econometric Techniques

In this section, I use two alternative econometric techniques to assess empirically the importance of potential tradeoffs between unemployment and poverty. The first technique focuses on short-run dynamics; it is based on a vector autoregression (VAR) model involving a small set of stationary variables, which includes unemployment and poverty. The second involves cross-country regressions of poverty rates on a variety of structural and macroeconomic variables, with unemployment being among the explanatory variables.

2.1 A VAR Framework

A first approach to determining whether unemployment and poverty move in opposite directions in response to shocks in the short term is to specify a parsimonious VAR consisting of the detrended components of output, the open unemployment rate, real wages, and the poverty rate. These variables are chosen on the premise that in the short term an output shock, for instance, is transmitted to poverty primarily through two channels: either a change in unemployment or a change in real wages.[15] In general, the impact of a shock on poverty will depend on what group is hit the hardest by the rise in unemployment or the fall in real wages. If movements in these two variables primarily affect prime-age working males with low education, poverty may increase significantly. The VAR may thus need to include a measure of unemployment that closely reflects the labor market conditions faced by young or unskilled workers (as a proxy for vulnerable groups), and a real wage index that is representative of wages earned by the poor—say, an index of unskilled workers' wages or wages in the informal sector.

I applied this procedure to Brazil and Chile, using annual data in both cases. The estimation period is 1981–2002 for Brazil and 1981–2001 for Chile. In both countries, the issue of assessing the impact of macroeconomic variables on poverty has received significant attention.

15. As noted by Agénor (2002a), output shocks may also be accompanied by changes in intrafamily allocation of income or government transfers, which are not captured by movements in wages. Moreover, changes in open unemployment may not be highly correlated with output fluctuations, because adjustment to changes in labor demand takes the form of large movements in the labor force between the formal and informal sectors. Under such conditions, the open unemployment rate should be replaced by a measure of the size of the informal sector.

Paes de Barros, Corseuil, and Leite (2000), for instance, in a study based on microeconomic simulation techniques, find that unemployment has a major impact on the behavior of poverty rates in Brazil. However, none of the existing studies address the issue of potential tradeoffs between unemployment and poverty.

For both countries, I estimate the trend component of each variable by using a modified version of the ideal band pass filter of Baxter and King (1999), as proposed by Christiano and Fitzgerald (2003). The Baxter-King filter is a linear transformation of the data, which leaves intact the components within a specified band of frequencies and eliminates all other components. Its application requires a large amount of data, however. Christiano and Fitzgerald (2003) propose the following approximation. Let y_t be the data series that would result from applying the ideal band pass filter to the raw data, x_t. Then y_t is approximated by $\hat{y}_t$, which is a filter of x_t, with weights chosen to minimize the mean square error:

$$E\left[\left(y_t - \hat{y}_t\right)^2 \middle| x\right].$$

Specifically, $\hat{y}_t$ is computed as

$$\hat{y}_t = B_0 x_t + B_1 x_{t+1} + \ldots + B_{T-1-t} x_{T-1} + \tilde{B}_{T-t} x_T + B_1 x_{t-1} + \ldots + B_{t-2} x_2 + \tilde{B}_{t-1} x_1 ,$$

for $t = 1, 2, 4, \ldots, T$, where

$$B_j = \frac{\sin(jb) - \sin(ja)}{\pi j}, \; j \geq 1 ,$$

$$B_0 = \frac{b-a}{\pi}, \; a = \frac{2\pi}{p_u}, \; b = \frac{2\pi}{p_l},$$

and $\tilde{B}_{T-t}$ and $\tilde{B}_{t-1}$ are linear functions of the values of B_j

$$\tilde{B}_{T-t} = -\frac{1}{2} B_0 = \sum_{j=1}^{T-t-1} B_j ,$$

and $\tilde{B}_{t-1}$ solves

$$0 = B_0 + B_1 + \ldots + B_{T-t-1} + \tilde{B}_{T-t} + \ldots + B_{t-2} + \tilde{B}_{t-1} ,$$

with $p_u = 24$ and $p_t = 2$ in the present case.

Consider first the case of Brazil. The variables included in the VAR, which are defined more precisely in appendix A, are the (log of the) output gap and the cyclical components of the (log of the) aggregate unemployment rate, the real minimum wage, and the poverty gap, defined as the average shortfall of the income of the poor with respect to the national poverty line, multiplied by the headcount ratio (as defined earlier).[16] The real minimum wage plays a key role in the distribution of wages in Brazil (as noted, for instance, by Neri and Thomas, 2000), and it is a good proxy for the unskilled real wage, as time-series comparisons indicate that these two series are highly correlated.

Augmented Dickey-Fuller (ADF) stationary tests indicated that all the variables, as defined here, are stationary.[17] A standard VAR approach (that is, one that ignores cointegrating relationships between the variables in level form) can therefore be used.[18] Figure 4 shows the evolution of the cyclical components of all the variables included in the VAR. The data illustrate fairly well the pro-cyclical behavior of the real minimum wage and the counter-cyclical behavior of unemployment and poverty.

Variables in the VAR are ordered as follows: output gap—real minimum wage—unemployment rate—poverty rate. The fact that the output gap and the unemployment rate are placed before the poverty rate in the VAR captures the assumption that shocks to poverty have no contemporaneous impact on these variables. Any contemporaneous correlation between a disturbance to the poverty rate and the output gap, for instance, is thus taken to reflect causation

16. The poverty gap is defined as

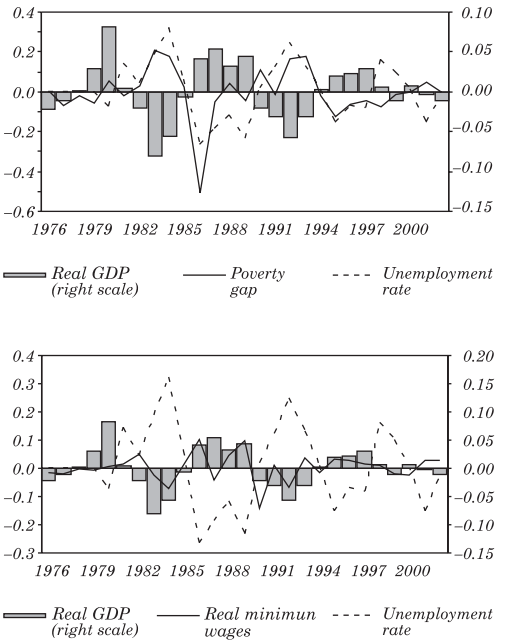
$$P_G = \left(ny^*\right)^{-1} \sum_{i \in L} \left(y^* - y_i\right),$$

where $y^* - y_i$ measures, for individual i in poverty, the gap between income, y_i, and the poverty line, y^*; L is the set of all poor; and n is the total number of poor.

17. The ADF test statistics were –3.418 for the cyclical component of the poverty rate (significant at the 5 percent level, using MacKinnon critical values for rejection of the null hypothesis), –2.978 for the detrended component of unemployment (significant at the 10 percent level), –3.889 for the cyclical component of the real minimum wage (significant at the 1 percent level), and –4.975 for the detrended component of output (significant at the 1 percent level).

18. Alternatively, all variables in the VAR could be measured in levels, despite being nonstationary. As shown by Sims, Stock, and Watson (1990), least-squares estimates are consistent for the levels specification (whether or not cointegration exists), whereas a differenced specification is inconsistent if some variables are cointegrated. In the absence of cointegration, the estimated standard errors of the levels specification are not consistent, so conventional inference could potentially be misleading.

Figure 4. Brazil: Cyclical Components of Real GDP, Unemployment Rate, Real Wages, and Poverty Gap, 1976-2002[a]



a. The cyclical component of each variable is defined as the log difference of the variable from its trend value calculated by using the Baxter-King filtering method.

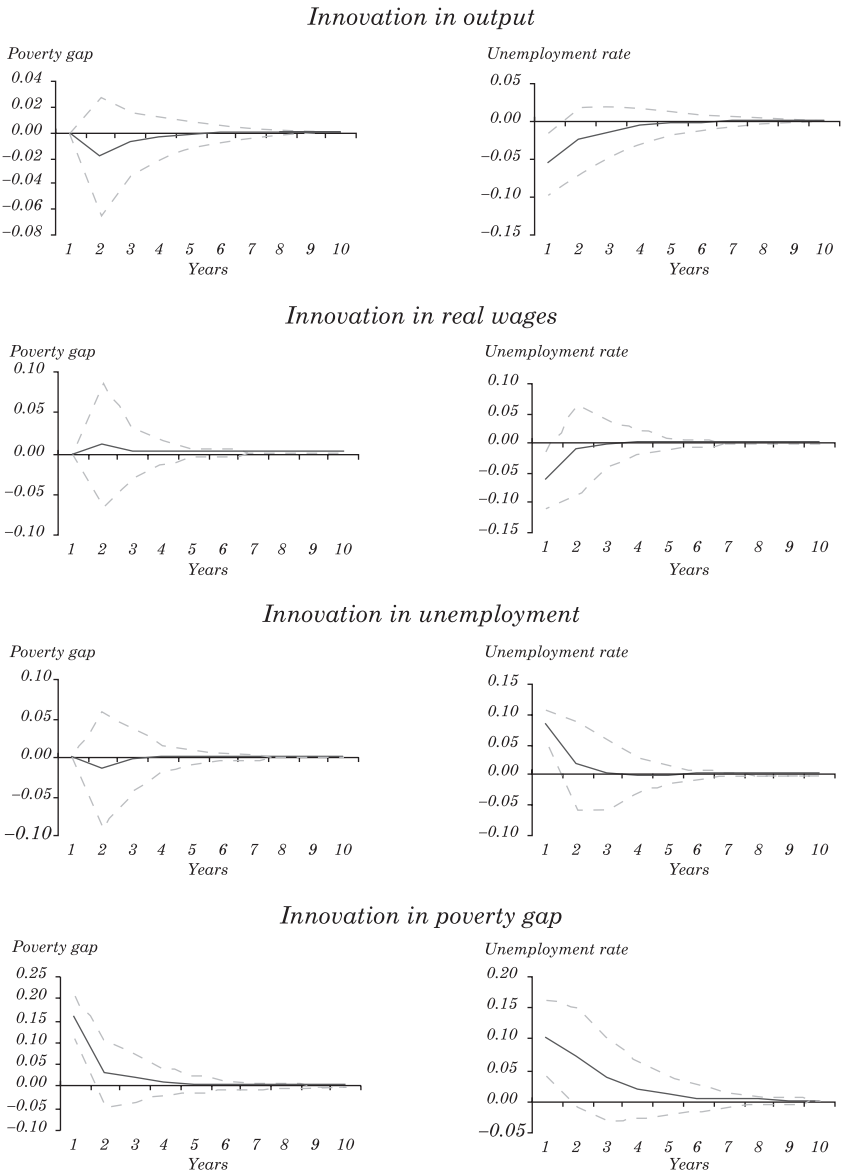
from output to poverty, and not the other way around.[19] I used the Akaike criterion to choose the optimal lag length. Given the relatively small size of the sample, I only compared models with one and two lags. The test led to the selection of one lag as the optimal choice.

The impulse response functions of the poverty gap and unemployment associated with a one-standard-deviation shock to the innovation in all the variables included in the VAR are shown in figure 5. The solid lines in the figures represent the impulse responses themselves, whereas the dotted lines are the associated 95 percent upper and lower confidence bands.[20] An innovation in output lowers unemployment (as

19. Alternative orderings were also considered, with either the poverty rate or the unemployment rate always appearing last in the sequence. The results were virtually unchanged.

20. The confidence intervals were generated with EViews, using a procedure based on analytical derivatives.

Figure 5. Brazil: Impulse Response Functions[a]



a. Cyclical components of each variable are used. The VAR model is estimated using a one-period lag. Each innovation corresponds to one standard deviation of the respective variable.

expected) but has no statistically significant effect on poverty. An innovation in real wages has, again, no effect on poverty and a perverse effect on unemployment in the first period. An innovation in the unemployment rate raises unemployment, of course, with no effect on poverty, whereas an innovation in the poverty gap has a positive and significant effect on both variables.

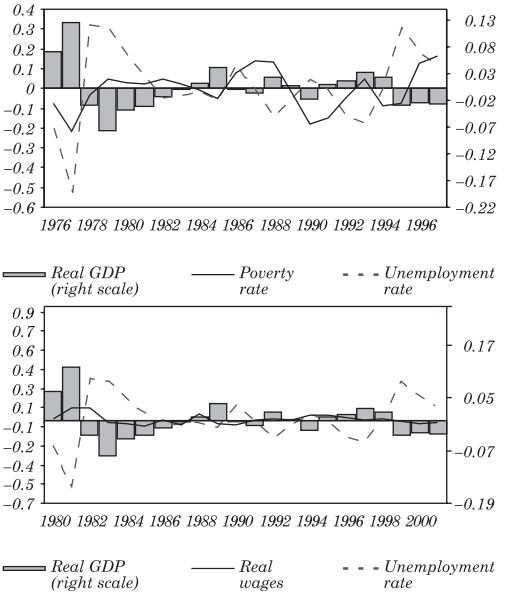
Consider now the case of Chile. The variables included in the VAR are the (log of the) output gap and the cyclical components of the (log of the) urban unemployment rate, the real wage for unskilled labor, and the headcount poverty index for the Santiago Metropolitan area.[21] ADF tests also indicated that all these variables are stationary.[22] Figure 6 displays the cyclical components of all the variables. Although real unskilled wages seem to fluctuate relatively little over time, they do show some degree of procyclicality. Both unemployment and poverty are countercyclical. Unemployment seems to fluctuate a lot more than poverty, however, and in the 1990s the two variables appear to be negatively correlated—an observation that would be consistent with a tradeoff between them, despite the fact that the sample period is small. Using the same ordering as before and uniformly selecting one lag (based on the Akaike criterion), I calculated the impulse response functions of the poverty gap and unemployment. The results, illustrated in figure 7, indicate that a positive innovation in output lowers unemployment and raises unskilled wages (again, as expected), but it has no direct, discernible effect on poverty. An innovation in real wages has no statistically significant effect on either one of the variables of the system. Unemployment shocks have no significant impact on poverty, and conversely poverty shocks do not affect unemployment.

Overall, therefore, the results for Brazil and Chile do not indicate the existence of a short-term tradeoff between poverty reduction and unemployment. This result may be due to a variety of factors, including limitations in the data. For instance, the aggregate unemployment rate was used in both cases, instead of the unskilled unemployment rate; the latter would be more appropriate given the correlation between education and poverty levels. More

21. More precise definitions of these variables are provided in appendix A. The VAR model was also estimated with a measure of extreme poverty and with an index of average wages in the urban sector. In both cases, the impulse response functions obtained were very similar to those reported here.

22. The ADF test statistics were –4.479, –3.461, –3.022, and –3.064 for the detrended components of, respectively, the poverty rate, the unemployment rate, the real unskilled wage, and real GDP. All these statistics are significant at a 5 percent threshold or higher.

Figure 6. Chile: Cyclical Components of Real GDP, Unemployment Rate, Real Wages, and Poverty Gap, 1980-2001[a]



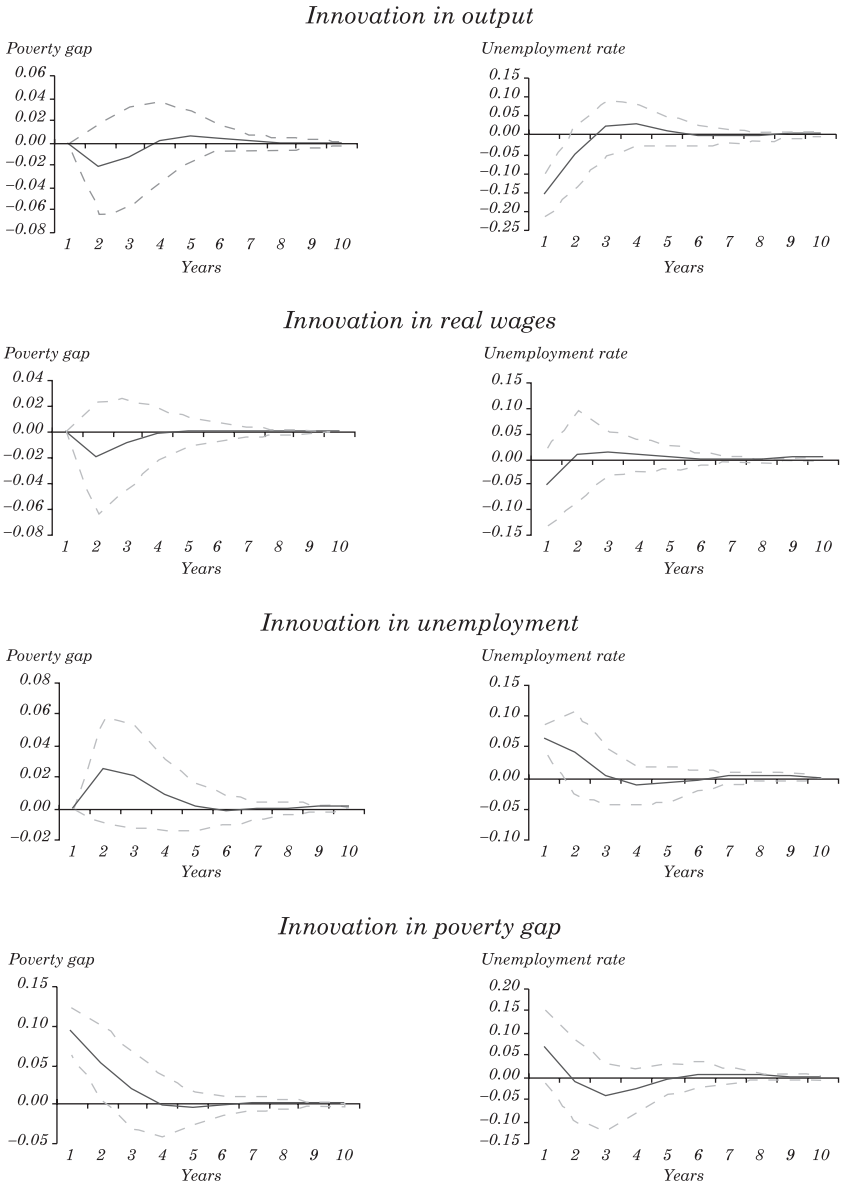
a. The cyclical component of each variable is defined as the log difference of the variable from its trend value calculated by using the Baxter-King filtering method.

advanced approaches might also provide different results. One line of investigation would be to develop a structural VAR model, which would allow one to disentangle the importance of, say, real wage shocks, as opposed to, say, productivity shocks, in the behavior of poverty and unemployment. Alternatively, an error-correction framework would allow a possible distinction between short- and longer-term tradeoffs. This could be important because the fact that output shocks appear to have no effect on poverty in a VAR in which all variables are entered in detrended form does not preclude the existence of a cointegrating relationship between the raw output and poverty series themselves.

2.2 Cross-country Regressions

As noted earlier, if both unemployment and poverty are viewed as jointly endogenous, a key issue then becomes to identify the ultimate source of the differences in unemployment, growth, and poverty, either over time (at the level of an individual country) or across countries. Fig-

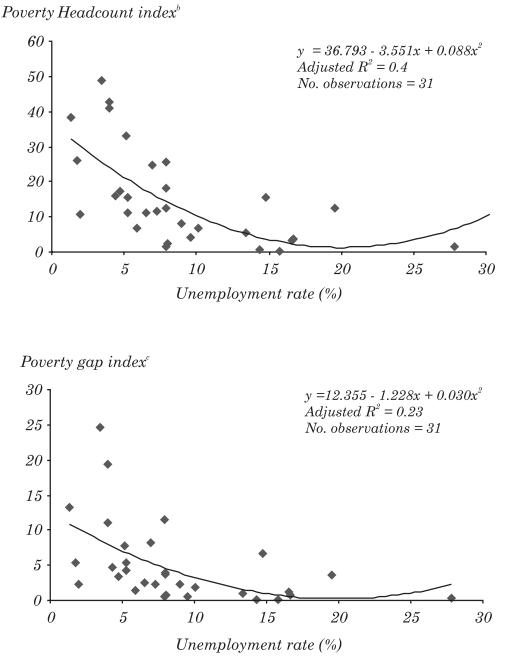
Figure 7. Chile: Impulse Response Functions[a]



a. Cyclical components of each variable are used. The VAR model is estimated using a one-period lag. Each innovation corresponds to one standard deviation of the respective variable.

ure 8 displays data for a group of thirty-one developing countries on two standard measures of poverty (the headcount index and the poverty gap, both defined earlier) and the open unemployment rate. The number of countries corresponds to all those for which matching data were obtained between the World Bank and the ILO databases on these variables. Each data point is an average of all available observations for each country. The figure suggests a negative correlation (and thus a potential tradeoff) between poverty and unemployment across countries. Moreover, a simple cross-section regression of poverty on unemployment (also shown in the figure) suggests that the relation between these variables is convex: the correlation appears to turn positive beyond a rate of unemployment of about 20 percent—specifically, 3.551/(2*0.088) = 20.2 for the headcount index, and 1.228/(2*0.03) = 20.5 for the poverty gap.

Figure 8. Developing Countries: Unemployment and Poverty[a]
percent



Source: World Bank Global Poverty Monitoring and ILO.
a. Samples consist of thirty-one countries for which data are available in the World Bank Global Poverty Monitoring (http://www.worldbank.org/research/povmonitor/) and ILO.
b. Proportion of the population earning 1.08 US dollar or less a day, various survey years.
c. Poverty gap at 1.08 US dollar or less a day, various survey years.

However, given the small number of data points in that range, it is difficult to draw much from this increasing portion of the curve, despite the statistical significance of the quadratic term in unemployment in the regression.

A simple explanation for the negative correlation between unemployment and poverty shown in the figure is that it reflects the fact that poor countries often have a large informal sector, such that open (or officially measured) unemployment tends to be small. At the same time, the urban poor tend to be highly concentrated in the informal sector. Thus, a large informal sector corresponds to a lower open unemployment rate (reflecting higher disguised unemployment) and a higher poverty rate. There are two problems, however, with this interpretation. First, it does not appear to hold in some regions. In the Middle East and North Africa, most notably, a good part of unemployment is voluntary in nature and affects the educated. The link between unemployment and poverty thus tends to be weak: the World Bank (2004) finds, using microeconomic data, that poverty and labor market status are not closely correlated in that region. Second, this interpretation does not appear to be sufficient; in the cross-country econometric results discussed later, I control indirectly for the size of the informal sector by using income per capita as a regressor (the lower the standards of living, the larger is the size of the informal economy), and the negative correlation between unemployment and poverty persists.

To assess the relation between these two variables over time and across countries, I specify and estimate a cross-country regression model, using unbalanced panel data for a group of developing economies. The dependent variable is either the headcount index or the poverty gap, based on the international poverty line of $1.08 a day. Based on my previous results (see Agénor, 2002a, 2002b, 2004a), I included the following explanatory variables in the regressions, in addition to the unemployment rate: INFL is the inflation rate in terms of consumer prices; LGDPPC is the log of gross domestic product (GDP) per capita at purchasing power parity (PPP) exchange rates, which captures the level of economic development and the effect of economic growth on standards of living; REALEX is the rate of change of the real effective exchange rate (defined such that an increase is a depreciation); VREALXL is a measure of macroeconomic volatility, which consists of rolling standard deviations of the real exchange rate; and TARIFF is the average tariff rate (total tariff revenue divided by the value of imports).[23]

23. See appendix A for more precise definitions and sources.

I have discussed at length elsewhere the rationale for considering these variables (see Agénor, 2002a, 2002b, 2004a), so only a brief justification is offered here. Inflation (which is a tax on nonindexed financial assets, such as currency holdings) lowers the overall purchasing power of households and tends to raise poverty. An increase in real GDP per capita is expected to be negatively correlated with the poverty rate. The effect of a real exchange rate depreciation is ambiguous. It may lead to a reduction in poverty if it benefits small farmers in the tradable sector (as is the case in many low-income developing countries); but overall poverty may increase if the depreciation is accompanied by a significant increase in the cost-of-living index in urban areas (as a result of a rise in the domestic price of imported goods). The average tariff rate is a proxy for the degree of trade openness, or "real" globalization, and is expected to have a nonlinear effect on poverty (see Agénor, 2004a): to the extent that trade liberalization entails short-run adjustment costs (as a result of a reduction in employment in import-substitution industries, for instance), poverty may rise initially; over time, as liberalization progresses and tariffs continue to fall, the expansion of employment in export industries may lead to lower poverty. This is tested by using both the average tariff rate and its squared value as regressors. The tariff rate itself is expected to have a negative effect on poverty, whereas its squared value is expected to have a positive effect.

The data on poverty rates are taken from the World Bank and cover countries for which data on the unemployment rate are simultaneously available from the ILO, with at least two observations available for each country. These requirements give a relatively small sample, consisting of eleven countries and forty observations (see appendix A). The first estimation method that I use is ordinary least squares (OLS) with fixed effects. The results are reported in table 1, columns 1 and 2 for the headcount index and columns 4 and 5 for the poverty gap. The difference between columns 1 and 2 and columns 4 and 5 is that the change in the real exchange rate, and the volatility measure based on it, are entered separately, because of colinearity between the variables. The results are very similar, however. Inflation raises poverty, whereas higher income per capita tends to reduce it. A real exchange rate depreciation and a high degree of real exchange rate volatility both tend to increase poverty. The tariff rate and its squared values have the expected sign—increased trade openness (a reduction in tariffs) tends to increase poverty at first and then reduces it beyond a certain threshold, a result consistent with the globalization-poverty curve discussed by Agénor (2004a) in a more general setting. The open unemployment rate also appears to have a nonmonotonic effect on poverty: lower unemployment is

associated with higher poverty, but an opposite effect kicks in at levels of unemployment of 0.033/(2*0.002) = 8.3 percent for the headcount index and 0.01/(2*0.001) = 5 percent for the poverty gap (regressions 1 and 4). These results corroborate at much smaller levels those shown in figure 8, which are based on a simple cross-section regression.[24] But again, caution is needed in interpreting the positive segment of the curve, given the small number of data points in that range.

To account for possible simultaneity problems with the control variables, I also used an instrumental variables procedure (together with fixed effects). In the first step, inflation, unemployment, income per capita, and the rate of depreciation of the real exchange rate (or the index of volatility based on it) were all regressed on the lagged values of each variable at $t-1$, $t-2$, and $t-3$, as well as on the tariff rate and its squared value. In the second step, the predicted values from these regressions were introduced in the poverty regression, together with linear and quadratic terms in the tariff rate. The estimation results are shown in columns 3 and 6 for the two measures of poverty and the percentage change in the real exchange rate. By and large, the estimates obtained with OLS are unaffected, except that the real exchange rate variable loses some of its significance. Most importantly for the issue at hand, the degree of significance of the coefficients on the unemployment rate and its squared value, as well as their size, increases. This implies slightly higher threshold levels for the unemployment rate to be positively correlated with poverty: 0.091/(2*0.05) = 9.1 percent for the headcount index and 0.028/(2*0.002) = 7.0 percent for the output gap.

Finally, I reran all the regressions using the employment ratio (as measured by the share of employment in total population) instead of the open unemployment rate, on the grounds that employment and total population are measured with a greater degree of precision than the labor force—perhaps because of the difficulty of accurately measuring changes in participation rates. The results, shown in table 2, are very similar to those reported in table 1, except for the fact that the coefficients on the linear and quadratic terms in the employment ratio have the opposite sign (as expected), and the quadratic term in the employment ratio, when the poverty gap is used and the instrumental variables methodology is applied, is only borderline significant.

24. The difference is that the cross-section regression attempts to explain the cross-country variation in poverty rates on the basis of the independent variables only, whereas the panel regressions explain some of the variation through separate intercepts (or fixed effects). The coefficient of the quadratic term in the panel regressions is determined with greater precision than in the cross-section regression, owing to the larger number of observations.

Table 1. Unemployment Rate and Poverty in Developing Countries, 1981–98[a]

	Headcount poverty index			Poverty Gap		
Explanatory variable	(1)	(2)	(3)	(4)	(5)	(6)
UNEMP	–0.033	–0.029		–0.010	–0.058	
	(–1.895)	(–2.048)		(–2.153)	(–2.034)	
UNEMP_SQ	0.002	0.001		0.001	0.001	
	(2.002)	(1.919)		(2.199)	(1.852)	
IVUNEMP			–0.091			–0.028
			(–3.497)			(–2.491)
IVUNEMP_SQ			0.005			0.002
			(2.409)			(2.200)
INFL	0.007	0.006		0.003	0.003	
	(4.132)	(4.115)		(7.410)	(6.842)	
IVINFL			0.047			0.021
			(15.192)			(9.318)
REALEX	0.087			0.021		
	(2.139)			(1.759)		
IVREALEX			0.373			0.129
			(1.472)			(1.341)
VREALXL		0.198			0.034	
		(2.103)			(1.249)	
LGDPPC	–0.176	–0.200		–0.053	–0.056	
	(–9.802)	(–3.299)		(–8.241)	(–3.310)	
IVLGDPPC			–0.188			–0.047
			(–5.374)			(–3.309)
TARIFF	–1.282	–1.420	–2.049	–0.606	–0.652	–0.902
	(–3.074)	(–3.679)	(–5.712)	(–4.027)	(–4.437)	(–6.106)
TARIFF_SQ	3.202	3.361	5.503	1.860	1.973	2.929
	(2.764)	(3.156)	(5.629)	(4.304)	(4.921)	(7.044)
Summary statistic						
Adjusted R^2	0.816	0.807	0.817	0.762	0.743	0.772
Total panel observations	40	38	38	40	38	38
Standard error of regression	0.041	0.042	0.041	0.014	0.014	0.014

a. The dependent variable is the headcount poverty index in regressions 1 through 3 (that is, the ratio of population earning less than USD 1.08 per day) and the poverty gap in regressions 4 through 6 (that is, the mean shortfall from the poverty line of USD 1.08 per day, expressed as a percentage of the poverty line). The estimation technique is ordinary least squares with fixed effects in regressions 1, 2, 4, and 5 and two-stage least squares with fixed effects in regressions 3 and 6. UNEMP is the rate of unemployment; UNEMP_SQ is its squared value. IVUNEMP is the instrumental variable of UNEMP (fitted values obtained by regressing UNEMP on the growth rate of GDP per capita (purchasing power parity) at $t-1$, $t-2$, and $t-3$, TARIFF, and TARIFF_SQ). IVUNEMP_SQ is the squared value of IVUNEMP. INFL is the annual change in the consumer price index. IVINFL is the instrumental variable of INFL (fitted values obtained by regressing INFL on INFL at $t-1$, $t-2$, and $t-3$, TARIFF, and TARIFF_SQ). REALEX is the annual change in the real effective exchange rate index (a rise is a depreciation). IVREALEX is the instrumental variable of REALEX (fitted values obtained by regressing REALEX on REALEX at $t-1$, $t-2$, and $t-3$, TARIFF, and TARIFF_SQ). VREALXL is the volatility measure of the real effective exchange rate, calculated as the ratio of the standard deviation of the variable for t, $t-1$, $t-2$, and $t-3$ to the average value for the same period. LGDPPC is the log of the GDP per capita (purchasing power parity). IVLGDPPC is the instrumental variable of LGDPPC (fitted values obtained by regressing LGDPPC on LGDPPC at t-1, t-2 and t-3, TARIFF, and TARIFF_SQ). TARIFF is the average tariff rate and TARIFF_SQ is its squared value; t statistics are in parentheses.

Table 2. Employment Ratio and Poverty in Developing Countries, 1981–98[a]

	Headcount poverty index			*Poverty Gap*		
Explanatory variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
EMP	8.513	9.036		2.661	2.310	
	(3.325)	(3.539)		(2.850)	(2.504)	
EMP_SQ	–8.438	–9.567		–2.388	–2.124	
	(–3.169)	(–3.411)		(–2.451)	(–2.156)	
IVEMP			6.393			1.414
			(6.546)			(2.206)
IVEMP_SQ			–6.295			–1.036
			(–5.628)			(–1.572)
INFL	0.005	0.005		0.003	0.002	
	(2.431)	(2.596)		(4.812)	(5.032)	
IVINFL			0.033			0.013
			(2.008)			(1.523)
REALEX	0.088			0.023		
	(3.014)			(2.642)		
IVREALEX			0.241			0.201
			(0.982)			(1.856)
VREALXL		0.218			0.038	
		(2.914)			(1.703)	
LGDPPC	–0.165	–0.172		–0.060	–0.063	
	(–3.208)	(–3.519)		(–3.370)	(–3.092)	
IVLGDPPC			–0.185			–0.073
			(–3.697)			(–3.184)
TARIFF	–0.763	–0.948	–1.291	–0.411	–0.497	–0.392
	(–1.628)	(–2.255)	(–2.222)	(–2.508)	(–3.385)	(–1.687)
TARIFF_SQ	3.011	3.236	4.720	1.703	1.856	1.635
	(2.756)	(3.274)	(2.857)	(4.254)	(5.033)	(2.430)
Summary statistic						
Adjusted R^2	0.850	0.839	0.889	0.788	0.755	0.788
Total panel observations	40	38	31	40	38	31
Standard error of regression	0.037	0.038	0.033	0.013	0.014	0.013

a. The dependent variable is the headcount poverty index in regressions 1 through 3 (that is, the ratio of population earning less than USD 1.08 per day) and the poverty gap in regressions 4 through 6 (that is, the mean shortfall from the poverty line of USD 1.08 per day, expressed as a percentage of the poverty line). The estimation technique is ordinary least squares with fixed effects in regressions 1, 2, 4, and 5 and two-stage least squares with fixed effects in regressions 3 and 6. EMP is the ratio of employment to total population; EMP_SQ is its squared value. IVEMP is the instrumental variable of EMP (fitted values obtained by regressing EMP on the lagged values of EMP at $t-1$, $t-2$, and $t-3$, TARIFF, and TARIFF_SQ). IVEMP_SQ is the squared value of IVEMP. INFL is the annual change in the consumer price index. IVINFL is the instrumental variable of INFL (fitted values obtained by regressing INFL on INFL at $t-1$, $t-2$, and $t-3$, TARIFF, and TARIFF_SQ). REALEX the annual change in the real effective exchange rate index (a rise is a depreciation). IVREALEX is the instrumental variable of REALEX (fitted values obtained by regressing REALEX on REALEX at $t-1$, $t-2$, and $t-3$, TARIFF, and TARIFF_SQ). VREALXL is the volatility measure of the real effective exchange rate, calculated as the ratio of the standard deviation of the variable for t, $t-1$, $t-2$, and $t-3$ to the average value for the same period. LGDPPC is the log of the GDP per capita (purchasing power parity). IVLGDPPC is the instrumental variable of LGDPPC (fitted values obtained by regressing LGDPPC on LGDPPC at $t-1$, $t-2$, and $t-3$, TARIFF, and TARIFF_SQ). TARIFF is the average tariff rate and TARIFF_SQ is its squared value; t statistics are in parentheses.

Overall, therefore, the results suggest that when unemployment is below a threshold of about 10 percent, a tradeoff seems to exist between poverty and unemployment across countries. The next step would be to determine the exact source of this tradeoff—for instance, changes in labor market regulations during the sample period, as suggested by the model of Bean and Pissarides (1993) discussed earlier. This could be done by estimating a simultaneous equations system in unemployment and poverty rates, with the explicit introduction of an index of labor market regulations and other variables likely to affect unemployment (such as the presence of a binding minimum wage or a compensation scheme for the unemployed).

3. A Structural Approach

Another approach that can be used to gauge the extent to which poverty-unemployment tradeoffs are important, depending on the origin of shocks, is to use a numerical model and perform relevant simulations. I do so here with the Mini Integrated Macroeconomic Model For Poverty Analysis (mini-IMMPA) model, which was developed at the World Bank to quantify poverty reduction strategies in developing countries.[25] An appealing feature of the model is its detailed treatment of the labor market and the sources of unemployment in a typical developing-country context. I first describe the macroeconomic component of the model, emphasizing the production side and the structure of the labor market, and explain briefly how it is linked to a household survey for poverty analysis. Other features of the model (such as the composition of aggregate demand, the determination of prices, and the distribution of income flows) are briefly summarized in appendix B. I then report simulation results associated with two types of labor market reforms: a cut in the minimum wage and a reduction in payroll taxes on unskilled labor in the formal sector.

3.1 Production and the Labor Market

The structure of production and the labor market in Mini-IMMPA are summarized in figure 9. Production activities take place in both

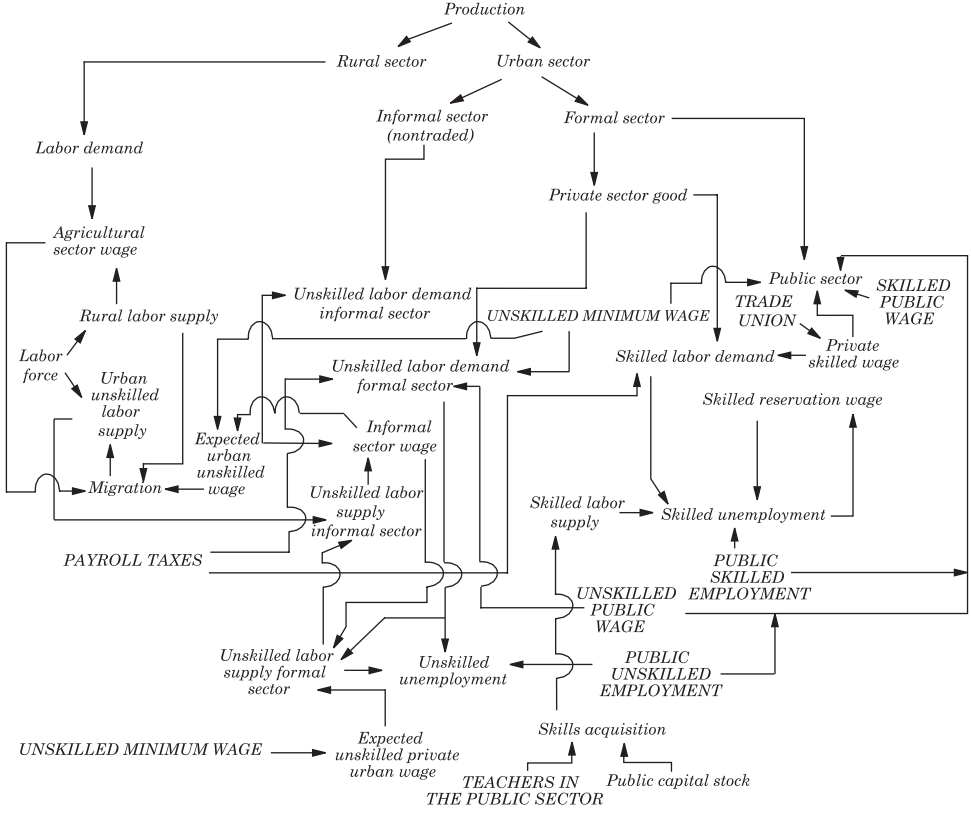
25. See Agénor (2003), Agénor and El Aynaoui (2003), Agénor, Izquierdo, and Fofack (2003), Agénor, Fernandes, and Haddad (2003), and Agénor and others (2004).

rural and urban areas. The rural sector produces only one good, which is sold either on domestic markets or abroad. Urban production includes both formal and informal components; in addition, the urban formal economy is separated between production of private and public goods. Gross output of each type of good is given by the sum of value-added and intermediate consumption. Value-added in the rural sector is assumed to be produced with land (which is in fixed supply) and a composite factor, which consists of unskilled labor and public capital. Value added in the urban informal sector depends only on labor and is subject to decreasing returns to scale. Value-added in the public sector is measured by the government wage bill, and employment is exogenous. Private formal production uses as inputs both skilled and unskilled labor, as well as public and private capital. Skilled labor and private physical capital have a higher degree of complementarity (lower degree of substitution) than the physical capital-skilled labor bundle with unskilled labor. Firms in the urban formal sector are subject to a payroll tax on unskilled labor.

Unskilled workers are employed in both the rural and urban sectors, whereas skilled workers are employed only in the urban formal economy. Wages in the rural and urban informal sectors adjust to equilibrate supply and demand. Unskilled workers in the urban economy may be employed in either the formal sector, in which case they are paid the minimum wage, or the informal economy, where they receive the going wage. The nominal wage for skilled labor in the private sector is determined on the basis of a monopoly union approach, as in Agénor (2004b). The consumption real wage is set by a representative labor union, whose objective is to maximize a utility function that depends on deviations of both employment and the consumption wage from their target levels, subject to the firm's labor demand schedule. The union's target wage is related negatively to the skilled unemployment rate. Education is a pure public good; the flow of unskilled workers who become skilled is a function of the effective number of teachers in the public sector and the stock of public capital in education.

Incentives to rural-urban migration depend on the differential between expected rural and urban wages, as in Harris and Todaro (1970). The expected (unskilled) urban wage is a weighted average of the minimum wage in the formal sector and the going wage in the informal sector. The degree of mobility of the unskilled labor force between the formal and informal sectors is also imperfect and is a function of expected income opportunities. The supply of labor in the

Figure 9. Production Structure and the Labor Market



Source: Agénor (2002).

informal economy is obtained by subtracting the number of unskilled job seekers in the urban formal sector from the urban unskilled labor force, which increases as a result of natural urban population growth and migration from the rural economy and which falls because some unskilled workers acquire skills and leave the unskilled labor force to increase the supply of skilled labor.

3.2 Link with a Household Survey

The procedure followed here to assess the poverty effects of policy shocks involves linking the structural macroeconomic component described earlier to a household income and expenditure survey, in order to calculate both the headcount index and the poverty gap. This procedure, which is discussed at length in Agénor, Chen, and Grimm (2004) and Agénor, Izquierdo, and Fofack (2003), involves six steps. The first step is to classify the data in the household survey into the five categories of households contained in the macroeconomic framework—workers in the rural sector, unskilled workers in the urban informal sector, unskilled workers in the urban formal sector, skilled workers in the urban formal sector, and profit earners (see appendix B).

The second step is to initiate a shock and then generate the subsequent real growth rates in real per capita consumption and disposable income for all categories of households, up to the end of the simulation horizon. The third step is to apply these growth rates separately to the per capita (disposable) income and consumption expenditure for each household in the survey. This gives a new vector of absolute income and consumption levels for each individual in each group.

The fourth step is to update the initial rural and urban poverty lines to reflect increases in rural and urban price indexes and then to calculate poverty indicators using the new vector of absolute levels of income and consumption. The fifth step uses employment and unemployment growth rates to adjust the composition of the sample of each household group, as given in the survey. Finally, the sixth step is to compare the post-shock poverty indicators with the baseline values to assess the impact of the shock on the poor.

3.3 Policy Shocks

This subsection examines the poverty and employment effects of two types of labor market reforms: a cut in the minimum wage and a reduction in the payroll tax rate on unskilled labor paid by firms in the

private formal sector. Discussions of the employment effects of changes in minimum wages and the taxation of labor figure prominently in the recent debate on labor market reforms in developing countries (see, for instance, Agénor, 2004c; World Bank, 2004). Assessing whether these policies may entail tradeoffs between unemployment reduction and poverty alleviation is thus timely. In both simulations, I consider only permanent shocks and focus on the first ten periods after the shock. For the payroll tax experiment, I consider three alternative budget financing rules: domestic borrowing with no offsetting tax change; and offsetting, revenue-neutral increases in either sales taxes on private formal sector goods or income taxes on profit earners.[26] In all of these experiments, the government borrows domestically to finance its deficit, and private capital formation is determined residually to maintain a continuous equilibrium between aggregate savings and investment.[27]

Reduction in the minimum wage

Simulation results associated with a 10 percent reduction in the minimum wage are shown in table 3, which displays absolute percentage changes from the baseline solution of unemployment (both skilled and unskilled) and poverty rates (for informal sector households, formal unskilled households, and formal skilled households), as measured by the poverty gap.

The impact (or first year) effect of the reduction in the minimum wage is an increase in the demand for unskilled labor in the private sector on the order of 4.3 percent. The increase in demand is met by the existing pool of unskilled workers seeking employment in the urban sector. As a result, the unskilled unemployment rate drops significantly, by 2.9 percentage points in the first year. The cut in the minimum wage reduces the relative cost of unskilled labor, which leads to substitution among production factors not only on impact but also over time. Because unskilled labor has a relatively high elasticity of substitution with respect to the composite factor consisting of skilled labor and physical capital, the reduced cost of that category of labor gives private firms in the formal sector a fairly strong incentive

26. The calibration procedure and parameter values used in these simulations are described in appendix C. Detailed tables summarizing the simulation results are available on request.

27. How this transfer of private savings to the government takes place is not explicitly specified; one can think of a pure financial intermediary operating in the background.

to substitute away from skilled labor and physical capital. The fall in the demand for that category of labor puts downward pressure on skilled wages, which drop by 1.6 percent in the first period. On impact, labor supply is fixed in the rural and informal sectors, so the level of employment does not change in either sector—and neither does the level of activity (that is, real value-added in both sectors is constant). The rise in real disposable income and real consumption of rural and informal sector households leads to higher value-added prices and higher wages in both sectors. Value-added prices go up by slightly more than wages in the second and subsequent periods, implying a fall in the product wage in both sectors and a rise in employment.

Over time, changes in wage differentials affect both rural-urban and formal-informal migration flows and, therefore, the supply of labor in the various production sectors. The expected unskilled wage in the formal economy is constant on impact. Despite the increase in unskilled employment in the private sector in the first period (implying a higher perceived probability of finding a job in that sector), the fall in the minimum wage is large enough to entail a reduction in the urban expected wage. At the same time, rural sector wages rise, thereby magnifying the fall in the expected urban-rural wage differential. In the second period, the drop in this differential (measured as a proportion of the rural wage) is 8.7 percentage points; it persists over time, although it narrows somewhat. As a result, the inflow of unskilled workers in the informal sector (measured as a proportion of the total supply of unskilled labor in the urban sector) falls by about 1.2 percentage points in periods 2 and 3. The reduction in the labor supply leads, in turn, to an increase in informal sector wages throughout the adjustment period. This increase in the informal sector wage, coupled with the reduction in the minimum wage (as well as the expected wage in the private urban formal sector, despite the higher employment probability), leads to a sharp drop in period 2 in the expected formal-informal wage differential. As a result, the number of unskilled workers willing to queue for employment in the formal private sector falls. The reduction in the number of job seekers, together with the sustained effect of the cut in the minimum wage on labor demand, explains the large impact on unemployment, which averages about 11 percent in the long run.[28]

28. Unskilled employment in the formal (private) sector increases by about 10 percent in the long run, whereas the number of unskilled job seekers in the formal economy drops by 4.5 percent.

Table 3. Simulation Results
Absolute deviations from baseline, unless otherwise indicated.

Simulated policy, affected variable, and sector[a]	*Period*									
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
Unskilled labor minimum wage										
Unemployment rate										
(urban formal sector)										
Unskilled	–2.90	–11.63	–9.63	–10.52	–10.63	–10.89	–11.08	–11.25	–11.39	–11.51
Skilled	0.29	0.14	0.19	0.19	0.19	0.20	0.20	0.20	0.21	0.21
Poverty gap (urban)										
Informal	–1.52	–0.58	–0.96	–0.97	–1.06	–1.12	–1.17	–1.22	–1.26	–1.30
Formal unskilled	1.01	–0.90	–0.51	–0.69	–0.72	–0.78	–0.82	–0.86	–0.89	–0.90
Formal skilled	0.31	0.17	0.22	0.21	0.22	0.22	0.22	0.21	0.22	0.20
Unskilled labor payroll tax rate—nonneutral										
Unemployment rate										
(urban formal sector)										
Unskilled	–0.90	–5.21	–3.79	–3.86	–3.55	–3.34	–3.10	–2.88	–2.66	–2.46
Skilled	0.31	0.23	0.25	0.24	0.25	0.25	0.25	0.25	0.25	0.25
Poverty gap (urban)										
Informal	–1.55	–0.92	–1.03	–0.94	–0.90	–0.85	–0.80	–0.75	–0.71	–0.66
Formal unskilled	0.06	–0.91	–0.60	–0.61	–0.53	–0.48	–0.42	–0.36	–0.30	–0.25
Formal skilled	0.33	0.25	0.28	0.27	0.27	0.26	0.25	0.25	0.25	0.26
Unskilled labor payroll tax rate—sales tax neutral										
Unemployment rate										
(urban formal sector)										
Unskilled	–2.07	–2.05	–1.88	–1.71	–1.54	–1.37	–1.21	–1.05	–0.90	–0.76
Skilled	0.25	0.25	0.25	0.25	0.26	0.26	0.26	0.26	0.26	0.26

Table 3. (continued)

Simulated policy, affected variable, and sector[a]	*Period*									
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
Unskilled labor payroll tax rate—sales tax neutral										
Poverty gap (urban)										
Informal	–0.49	–0.44	–0.40	–0.37	–0.33	–0.29	–0.25	–0.22	–0.19	–0.15
Formal unskilled	–0.31	–0.30	–0.25	–0.20	–0.15	–0.11	–0.06	–0.02	0.02	0.06
Formal skilled	0.24	0.24	0.25	0.25	0.25	0.24	0.24	0.24	0.25	0.26
Unskilled labor payroll tax rate—income tax neutral										
Unemployment rate (urban formal sector)										
Unskilled	–3.56	–3.49	–3.40	–3.30	–3.19	–3.09	–2.98	–2.87	–2.76	–2.66
Skilled	0.18	0.19	0.19	0.19	0.19	0.20	0.20	0.20	0.20	0.20
Poverty gap (urban)										
Informal	–1.05	–1.03	–1.00	–0.98	–0.95	–0.93	–0.90	–0.87	–0.85	–0.82
Formal unskilled	–0.35	–0.34	–0.32	–0.30	–0.27	–0.24	–0.22	–0.19	–0.17	–0.14
Formal skilled	0.44	0.46	0.48	0.49	0.49	0.48	0.48	0.49	0.52	0.54

a. All simulations involve a 10 percentage point cut in the indicated policy.

Although the behavior of nominal wages in the rural sector essentially reflects changes in value-added prices on impact, over time it is also affected by changes in output (induced by changes in households' disposable income and expenditure) and migration flows. After an initial increase in nominal wages, lower migration flows to urban areas begin to put downward pressure on rural wages, which end up falling (in nominal terms) by slightly less than 2 percent after ten years. As indicated earlier, the reduction in the cost of unskilled labor induces a substitution away from skilled labor, which brings a sustained fall in skilled wages in nominal terms. The overall effect on labor demand is not large; skilled employment in the private formal sector falls in the long run only slightly. Because the supply of skilled labor remains roughly constant throughout (public investment in education and the number of school teachers are held constant at their baseline values), the increase in the skilled unemployment rate (of about 0.3 percentage points in the long run) mirrors the drop in employment. The reason for the small effect on skilled employment is that the direct substitution effect associated with the reduction in the minimum wage is mitigated by a fall in the skilled wage, resulting from general equilibrium effects. The drop in the nominal skilled wage is larger than the fall in the value-added price of the private urban formal sector, implying a drop in the product wage. This, in turn, stimulates the demand for that category of labor.

Changes in real consumption and disposable income lead to significant differences in poverty patterns among urban households. As shown in table 3, poverty drops by 1.5 percentage points for informal sector households on impact, but it increases for both categories of workers in the formal sector (by 1.0 and 0.3 percentage points, respectively, for skilled and unskilled households). In the long run, poverty falls for unskilled workers in both the informal and formal sectors, whereas the slight increase in poverty recorded on impact for skilled workers persists. For that group of workers, the behavior of poverty tends to mirror the behavior of unemployment. Thus, the simulation results suggest the existence of a potential short-run tradeoff between unemployment and poverty: although the reduction in the minimum wage raises unskilled employment in the formal sector, it also increases poverty for households employed in that sector. Moreover, a longer-run tradeoff could potentially result from the fact that poverty among skilled workers increases (albeit slightly) in both the short and long term.

Cut in payroll tax on unskilled labor

Simulation results associated with a 10 percentage point reduction in the payroll tax rate on unskilled labor are also shown in table 3. The results correspond, as noted earlier, to three alternative budget financing rules: a nonneutral change involving domestic borrowing with no offsetting tax change; a revenue-neutral change on impact involving an increase in sales taxes on private formal sector goods; and a revenue-neutral change implying an offsetting increase in income taxes on profit earners.

Consider first the nonneutral experiment. The impact effect of a reduction in the payroll tax rate is qualitatively similar to a cut in the minimum wage, as discussed earlier: by reducing the effective cost of unskilled labor, it tends to increase immediately the demand for that category of labor. The unskilled unemployment rate drops by 0.9 percentage point in the first year and by an average of 2.5 percentage points in the long run. The reduction in the effective cost of unskilled labor also leads firms in the private urban formal sector to substitute away from skilled labor and physical capital, causing skilled employment to fall by about the same amount as in the previous experiment. The behavior of the (expected) urban-rural wage differential follows a pattern qualitatively similar to the one described in the previous experiment, although the magnitude of the initial effects are not as large. Most importantly, the expected formal-informal wage differential now increases in the second period. The reason is that the minimum wage does not change this time around, and the expansion in unskilled employment in the private formal sector raises the probability of finding a job there, thereby increasing the expected formal sector wage. The number of unskilled job seekers in the formal economy therefore increases, which explains why the reduction in the unemployment rate is significantly lower than in the previous case.[29] Changes in poverty among urban household groups follows a similar pattern as before. The long-run reduction in poverty in the informal sector is less marked, however, largely because wages do not increase by the same amount—the fall in open unskilled unemployment is less dramatic, so fewer workers seek employment in the formal sector. The impact effect on poverty among formal unskilled

29. This time, unskilled employment in the formal (private) sector increases by about 7.5 percent in the long run, but the number of unskilled job seekers in the formal economy increases as well, by 2.8 percent.

households is about the same, so the same type of tradeoffs identified earlier emerge.

Consider now the case in which the effect of the payroll tax cut on overall tax revenue is offset by either an increase in sales taxes on private formal sector goods or an increase in taxation of profit earners. In both cases, the impact and longer-run effects of the shock are qualitatively similar to those described earlier, although their magnitude differs. In particular, movements in the informal sector wage are less pronounced, in part because changes in rural-urban migration flows are not as large. The most important difference is that when the cut in payroll taxes is financed by an initial increase in income taxes, the fall in unskilled unemployment is larger in both the short and the long term, because the reduction in the after-tax rate of return on investment lowers the demand for physical capital, which has a high degree of substitution with unskilled labor. The reduction in poverty among informal and formal unskilled households and the increase in poverty among skilled households are also both larger on impact. Moreover, the long-run impact on poverty among formal unskilled households is negligible with an increase in sales taxes, whereas the long-run effects remain quite significant (and are even stronger for skilled households) with an increase in income taxes. As in the nonneutral experiment, poverty increases among skilled households but falls among unskilled households (both formal and informal). Unemployment among skilled workers rises at the same time that it falls among the unskilled.

Overall, the results indicate that there may be short- and longer-term tradeoffs between unemployment reduction and poverty alleviation among household groups. The magnitude of these tradeoffs depends on the nature of the financing rule that accompanies the shocks. While the results are specific to the policy shocks examined here (as well as to the nature of the model and the parameter values chosen for its calibration), one may surmise that these tradeoffs are more than mere curiosities and may well occur with other types of policy changes.

4. Concluding Remarks

The purpose of this paper has been to discuss analytically and assess empirically the potential short- and long-term tradeoffs that may arise between reducing poverty and lowering unemployment in developing countries. The first part provided a general discussion of the channels through which such tradeoffs may arise. The discussion

noted that the expansion in employment (resulting from either favorable productivity shocks or lower wages) may be skewed toward low-paying jobs, and as long as the labor supply does not increase significantly, the increase in the numbers of working poor may translate into both lower unemployment and higher poverty. Furthermore, poverty and unemployment are both endogenous variables, and the correlation between them may depend on the type of shocks affecting the economy, either over time or across countries. This general proposition was illustrated in a growth context using a simple overlapping-generations model based on Bean and Pissarides (1993). In the model, unemployment is created by matching frictions in the labor market. The analysis showed that an increase in workers' bargaining power leads to higher wages, which discourages firms from opening new vacancies. This tends to raise unemployment. At the same time, a higher income for workers increases savings, which can stimulate growth and reduce poverty (assuming that growth is distribution neutral). The net effect on the pool of savings cannot be determined a priori—and thus neither can the effect on growth and unemployment. Nevertheless, the model can generate an inverse correlation between unemployment and poverty as a result of this type of shock.

The second part of the paper used two econometric techniques to assess empirically the relevance of these tradeoffs: a VAR framework and cross-country regressions. Impulse response functions derived from VAR models estimated for Brazil and Chile showed no short-run tradeoff between these variables, for neither output nor wage shocks. However, improvements in the quality of the data used, and the application of more sophisticated forms of VAR models, could deliver different results. The regression results, by contrast, show a negative relation between unemployment and poverty (as long as unemployment is below a certain threshold), even after controlling for various other determinants of poverty (such as inflation, real income per capita, changes in the real exchange rate, macroeconomic volatility, and the degree of trade openness), and using different econometric estimation techniques (specifically, OLS and instrumental variables with fixed effects).

The third part used a structural macroeconomic model built specifically for labor market and poverty analysis—namely, the Mini-IMMPA framework developed by Agénor (2003). Simulation results showed that labor market reforms can induce both short- and long-run tradeoffs between the composition of unemployment and poverty. In particular, following a cut in the minimum wage, unskilled unemploy-

ment and poverty rates in the formal sector may well move in opposite directions for particular household groups. Similarly, unskilled unemployment and poverty among urban unskilled households may both fall in the long run, while skilled unemployment and poverty among urban skilled households may well increase. A tradeoff may therefore exist across labor categories. To the extent that such tradeoffs exist, the nature of the social welfare function (that is, the relative importance of the various labor or household groups in shaping government preferences) becomes crucial in choosing a given policy path.

APPENDIX A
Data Sources and Definition of Variables

This appendix first describes the sources of the data for Brazil and Chile used in this paper. It then lists the countries included in the regression results presented in tables 1 and 2 and provides a more precise definition of the variables used in the regressions, with their respective data sources.

VAR estimates are based on the period 1981–2002 for Brazil and 1981–2001 for Chile. All series are detrended using the modified band-pass filter proposed by Christiano and Fitzgerald (2003), as discussed in the text, and are defined as follows:

Y_CYC is the cyclical component of real GDP calculated as the log difference of real GDP and its trend component. Data sources for real GDP are the World Bank's *World Development Indicators* (WDI) for Brazil, and the Central Bank of Chile (CBC) for Chile.

POVER_CYC represents cyclical components of the poverty gap (for Brazil) and the urban headcount index (for Chile). For Brazil, the source is IPEA (www.ipea.gov.br), and for Chile unpublished estimates by the CBC, which are based on an urban poverty line defined as twice the cost of a representative basket of food.[30]

WAGE_CYC is the cyclical component of the real minimum wage (for Brazil) and the unskilled real wage (for Chile). The source is IPEA for Brazil and for CBC (based on INE surveys) for Chile.

UNEMP_CYC is the cyclical component of the aggregate unemployment rate (for Brazil), and the unemployment rate in the Santiago metropolitan area (for Chile). The source is IPEA (from the monthly employment survey of IBGE) for Brazil and the CBC (based on the monthly survey of the Universidad de Chile) for Chile.

Regressions are based on the following list of countries (years of observation on poverty and unemployment rates in parentheses): Brazil (1985, 1988, 1989, 1993, 1997), Colombia (1988, 1991, 1995, 1996), Costa Rica (1986, 1990, 1993, 1996), Indonesia (1996, 1998), Mexico (1992, 1995), Pakistan (1990, 1993, 1996), Peru (1994, 1996), Philippines (1985, 1988, 1991, 1994, 1997), Sri Lanka (1990, 1995), Thailand (1981, 1988, 1992, 1996, 1998), and Venezuela (1981, 1987, 1989, 1993, 1995, 1996). These countries are all those for which at least two data points on poverty (as measured by the poverty gap or the headcount

30. An unpublished note (available on request) prepared by Elías Albagli of the Central Bank of Chile describes these estimates of the poverty rate in more detail.

index) and the unemployment rate were simultaneously available in the ILO and World Bank databases.

The variables used in the regressions are defined as follows:

POV is the poverty gap and headcount index, calculated with a poverty line of $1.08 a day. Source: World Bank Global Poverty Monitoring Database.

UNEMP is the unemployment rate, defined as the ratio of the labor force that is without work but is available for and seeking employment, to the total labor force. Source: *Key Indicators of the Labor Market* database (ILO).

INFL is the inflation rate in terms of consumer prices. Source: WDI.

REALEX is the percentage change in the real effective exchange rate. A rise is a depreciation. Source: *International Financial Statistics*, IMF.

LGDPPC is the log of GDP per capita measured at purchasing power parity exchange rates. Source: WDI.

TARIFF is the average tariff rate, defined as the ratio of import duties over imports. Source: WDI.

APPENDIX B
Other Features of Mini-IMMPA

This appendix briefly summarizes some of the other features of Mini-IMMPA, in addition to the production and the labor market structure described in the text.

Both the informal and public sector goods are nontraded. Total supply in each sector is thus equal to gross domestic production. Rural and private urban formal goods, by contrast, compete with imported goods. The supply of the composite good for each of these sectors consists of a combination of imports and domestically produced goods. The demand for imported versus domestic rural and private urban goods is a function of relative domestic and import prices and of the elasticity of substitution between these goods. Allocation of output of rural and private urban formal sector goods to exports or the domestic market occurs along each sector's production possibility frontier. Efficiency conditions require that firms equate the domestic-export relative price to the opportunity cost in production.

For the rural and informal sectors, aggregate demand consists only of intermediate consumption and demand for final consumption (by both the government and the private sector), whereas aggregate demand for the public and private goods consists, in addition, of investment demand. Total demand for intermediate consumption of any good is the sum of the share of this good in the consumption of other sectors. Final consumption for each production sector is the summation across all categories of households of nominal consumption of this sector's good. Total investment by urban firms consists of purchases of private urban formal goods only.

The net or value-added price of output is given by the gross price net of indirect taxes, less the cost of intermediate inputs. World prices of imported and exported goods are exogenously given. The domestic currency price of these goods is obtained by multiplying the world price by the exchange rate, with import prices also adjusted by the tariff rate. Because the transformation function between exports and domestic sales of the rural and private urban goods is linearly homogeneous, the domestic sales prices are derived from the sum of export and domestic expenditure on rural and private goods in nominal terms divided by the quantity produced of these goods. For the informal and public sectors, the composite price is equal to the domestic market price, which is in turn equal to the output price. For the rural sector and private urban production, the substitution function

between imports and domestic goods is also linearly homogeneous, and the composite market price is determined accordingly by the expenditure identity. The nested production function of private urban formal goods is once again linearly homogeneous; prices of the composite inputs are derived in a similar fashion. The price of capital is equal to the price of private urban formal goods, because investment expenditure involves only purchases of that category of goods (as noted earlier). Consumption price indices for the rural sector and for urban unskilled and skilled workers are defined as weighted averages of prices of composite goods, with weights reflecting the share of these goods in each group's consumption basket.

Firms' profits in all sectors are defined as revenue minus total labor costs. Firms' income in the rural and informal sectors is equal to their profits, whereas firms' income in the urban formal economy is equal to their profits minus corporate taxes and interest payments on foreign loans. Household income consists of salaries, distributed profits, and government transfers. Households are defined according to both the type of labor and their sector of location, which yields five categories: workers in the rural sector, workers in the urban informal sector, skilled workers in the urban formal sector, unskilled workers in the urban formal sector, and profit earners. The rural household comprises all workers employed in the rural sector. The urban informal household consists of workers in the informal sector. The unskilled (skilled) urban formal household consists of all unskilled (skilled) workers employed in the formal sector, both public and private. Households in the rural sector and in the urban informal economy own the firms in which they are employed. Income of rural sector households is thus equal to the sum of production revenue and transfers from the government. Income of the urban formal skilled and unskilled households depends on government transfers and salaries. Firms provide no direct income, because these groups do not own the production units in which they are employed. Firms in the private urban sector retain a portion of their after-tax earnings to finance investment, and they transfer the remainder to profit earners (who also receive transfer payments).

Each category of households saves a constant fraction of its disposable income, which is equal to total income minus income tax payments. The portion of disposable income that is not saved is allocated to consumption. The accumulation of capital over time depends on the flow level of investment and the depreciation rate. The aggregate identity between savings and investment implies that total in-

vestment must be equal to total savings, equal to firms' after-tax retained earnings, total after-tax household savings, government savings, and foreign borrowing by firms. In the simulations reported in the text, this equation is solved residually for the level of private investment.

All value added in the production of public goods is distributed as wages. Government expenditures consist of government consumption and public investment, which consists of investment in infrastructure, education, and health. Infrastructure and health capital affect the production process in the private sector, as they both combine to produce the stock of public capital. Tax revenues consist of revenue generated by import tariffs, sales taxes, income taxes (on both households and firms in the private urban sector), and payroll taxes. Thus, the fiscal deficit is equal to tax revenue minus transfer payments, current expenditure on goods and services, total wage payments, and total investment expenditure. Finally, the external constraint implies that any current account surplus (or deficit) must be compensated by a net flow of foreign capital, given by the change in private and public foreign borrowing. This is obtained by an adjustment of the real exchange rate.

APPENDIX C
Calibration and Parameter Values

This appendix presents the characteristics of the data underlying the calibration procedure for the Mini-IMMPA prototype described in the text (see Agénor, 2003). The basic data set consists of a social accounting matrix (SAM) and a set of initial levels and lagged variables. The SAM encompasses twenty-seven accounts, including production and retail sectors (four accounts), labor production factors and profits (three accounts), enterprises (one account), households (five accounts), government current expenditures and taxes (nine accounts), government investment expenditures (three accounts), private investment spending (one account), and the rest of the world (one account). The data satisfy the double-entry accounting principle and can therefore be used to initialize model variables and calibrate level parameters, such as effective tax rates.

The characteristics of the SAM data and other data (including initial labor market quantities and debt and capital stocks) are summarized as follows. On the output side, agriculture and the informal sector account for 12 and 35 percent of total output, respectively. On the demand side, private current and capital expenditures account for 78 percent of GDP, whereas overall government expenditures account for 18 percent of GDP. The economy has a balanced current account but runs a trade surplus, amounting to 4 percent of GDP, to finance foreign interest payments.

Total investment expenditures amount to 22 percent of GDP, and the private sector account for two-thirds of these outlays. This implies that investment spending accounts for 19 percent of private expenditures and 40 percent of public expenditures. The public sector investment budget allocates 30 percent of expenditures to investment in the health sector, 30 percent to investment in the education sector, and 40 percent to investment in infrastructure. Furthermore, the public sector wage bill makes up 30 percent of overall public sector expenditures. The government is assumed to run a balanced budget in the base period and thus does not resort to domestic or foreign borrowing. Sales taxes and import tariffs make up more than 70 percent of total government revenues, whereas private income and corporate taxes account for less than 20 percent of revenues.

The trade balance is dominated by nonagricultural imports and exports. Agricultural exports account for only 8 percent of total export earnings, whereas nonagricultural imports account for 92 percent of

total imports. The level of trade openness (measured by the ratio of the sum of imports and exports to GDP) amounts to a moderate 40 percent. Because the economy runs a balanced current account in the base period, there is no private or public foreign borrowing. Nevertheless, the stock of external debt in the base period amounts to 51 percent of GDP (or 233 percent of export earnings), whereas foreign interest payments amount to 4 percent of GDP (or 18 percent of exports earnings).

Rural areas account for 29 percent of the total labor force, and the rest is concentrated in urban areas. Altogether, 47 percent of the workers are employed in some kind of urban informal occupation, whereas only 22 percent of the labor force is employed in the urban formal sector. Open unemployment among urban formal workers amounts to 2 percent of the total labor force. The formal labor force consists of 58 percent unskilled workers and 42 percent skilled workers, and unemployment rates are 10 percent among formal unskilled workers and 8 percent among skilled workers. Migration from rural to urban areas amounts to 1.3 percent of the rural population, and the urban-rural wage differential amounts to 54 percent of the rural wage. In comparison, unskilled labor migration from the informal to the formal sector amounts to 0.8 percent of the informal sector labor force, and the formal-informal wage differential amounts to 106 percent of the informal wage.

Seventeen elasticity parameters, which cannot be derived from the calibration procedure, have to be estimated. These parameters include constant elasticity of substitution (CES) in rural agricultural and private formal production (four parameters); CES Armington elasticities and constant elasticity of transformation (CET) for aggregating domestic composite goods and transforming domestic production (four parameters); elasticities related to rural-urban, and formal-informal sector migration (two parameters); elasticities related to the computation of ordinary and congested government capital (two parameters); the elasticity of effort by teachers and the elasticity of substitution between labor and capital in skill upgrading (two parameters); the elasticities related to determination of skilled labor wages (two parameters); and the elasticity of investment with respect to the desired private capital stock (one parameter). In addition, a set of minimum consumption levels (fifteen parameters) has to be determined, because they similarly cannot be derived from the calibration procedure.

The substitution elasticity between labor and government capital in rural production is set at 0.7, whereas elasticities in the nested private, formal sector production structure range from 0.7 between

skilled labor and capital to 1.2 between the skilled labor-capital bundle and unskilled labor. Import and export elasticities are uniformly set at 0.7 for agriculture and 1.5 for the private urban formal sector. This is again meant to reflect a lower-middle-income economy with low agricultural potential. The elasticity of rural-urban migration with respect to the relative rural-urban wage-differential is set at 0.4, while the elasticity of formal-informal migration with respect to the formal-informal wage ratio is set at 0.8.

The substitution parameter between infrastructure and health capital stocks are set at 0.5, and congestion is assumed to be absent (zero elasticity). The substitution elasticity between teachers and public capital in education in the production of skilled labor is set at 0.3, while the effort elasticity with respect to the relative wage ratio—a specification that follows Agénor and Aizenman (1999)—is set to 0.8. Furthermore, skilled wages in the private urban formal sector are assumed to be affected only by the skilled unemployment rate, with an elasticity of –2.0. Finally, the elasticity of private investment with respect to the desired growth rate of the private capital stock is set at 0.3.

Among the remaining parameters, the foreign interest rate on private borrowing is calibrated to 3.8 percent, while the public foreign interest rate is calibrated to 4.9 percent. In addition, the initial depreciation rates are calibrated to 6.4 percent for private capital and 3.9-5.8 percent for public capital (depending on whether investment is in education, health, or infrastructure).

Turning to the government budget, output and value-added tax rates range from 3.0 to 3.7 percent, whereas the tax rate on sales of the private urban formal sector and the payroll tax rate paid by firms in that sector are calibrated to 12.1 and 20.1 percent, respectively. Import tariffs range from 34 percent on private formal sector goods to 167 percent on agricultural goods, reflecting a country with significant protection on agriculture. Finally, the corporate income tax rate is set at 7.6 percent, while income tax rates on households range from 2.2–3.9 percent for rural agricultural and urban unskilled groups to 9.6–12.5 percent for the urban skilled group and capitalists-rentiers. As noted in the text, workers in the urban informal sector do not pay income taxes.

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