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A SYMPOSIUM ISSUE ON HOW INTERNATIONAL EXCHANGE, TECHNOLOGY, AND INSTITUTIONS AFFECT WORKERS

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A SYMPOSIUM ISSUE ON HOW INTERNATIONAL EXCHANGE, TECHNOLOGY, AND INSTITUTIONS AFFECT WORKERS

THIS SYMPOSIUM ISSUE draws on papers originally prepared as background material for *World Development Report 1995: Workers in an Integrating World.* The articles in the symposium were refereed in the usual way. The Editorial Board invited Ishac Diwan, who was a member of the team that prepared the report, and Michael Walton, who led the team, to write an introduction to the symposium.

How International Exchange, Technology, and Institutions Affect Workers: An Introduction

Ishac Diwan and Michael Walton

In a world of deepening trade links, rapid technological change, and weakening institutions, workers in rich and poor countries alike are concerned about their incomes and the security of their work. In contrast to the substantial quantity of analysis on industrial countries, relatively little careful work has been done on these issues in developing countries, especially in the context of the recent globalization of economic relations. Empirical work suggests that disequalizing trends in some developing countries may have been caused by the entry of low-income countries such as China into world production or by the greater quality and technological requirements of contemporary trade in goods. Whatever the source, these results raise questions about the viability of institutional mechanisms for supporting the income security and working conditions of workers. Many labor market regulations are already ineffective owing to weak enforcement capabilities. However, in most developing countries, there will be a rising fraction of workers in formal labor contracts, rising demands for formal mechanisms for dealing with income insecurity, and a potentially larger role for unions in an important segment of the workforce. Thus, it is of increasing importance to set the policy and institutional framework in a fashion that is both consistent with competitive pressures and supportive of workers' participation and security.

Rising wage disparities in the United States, persistent unemployment in Europe, and "hollowing out" (relocation abroad of production jobs) of employment structures in Japan reinforce workers' concerns about international economic relations and domestic institutional changes. Institutional support systems for workers—from European-style welfare states to Japanese-style firm-based security—are being forced to adapt to international competition and the shifting labor demands of new technologies. These workers' concerns have parallels in developing countries, where state-directed employment creation—whether through protection for industrial jobs or central planning—has been ineffectual.

New concerns over employment in developing countries resonate with two long-standing employment debates: the debate about the consequences of open-

Ishac Diwan is with the Economic Development Institute, and Michael Walton is with the East Asia and Pacific Region, both at the World Bank. The authors wish to thank Martin Rama and Adrian Wood for their comments. This symposium issue is made up of articles that were originally prepared as background papers for *World Development Report 1995: Workers in an Integrating World.*

ness for workers and the debate about the kind of regulatory and institutional framework that can support the security and working conditions of workers in a labor market usually dominated by rural and informal workers outside the ambit of formal rules.

These old issues have acquired fresh topicality for several reasons. First, although some talk of globalization is overblown, the circumstances of the 1990s differ from those of previous decades for the developing world. With the fall in protectionism and the demise of central planning, the proportion of the world's workers who are shielded from the influence of international economic forces likely will drop from around two-thirds in the late-1970s to about one-tenth by the end of the 1990s (see World Bank 1995b). Second, evidence from some countries, especially in Latin America, indicates that wage inequalities increased over the past decade, coinciding with rising openness. Third, workers in many countries perceive as a threat the entry of China and other low-income countries into international trade. Fourth, increasingly, people in rich countries worry about the conditions of work in poor countries and are afraid that international exchange will force all workers into insecure work in unhealthy conditions. And fifth, within countries, workers and policymakers debate about the role of labor regulations, unions, and public employment policy in a world of rising interconnections and apparently rapid structural change.

The employment debates are rarely informed by careful analysis. The articles in this issue seek to address some of the open questions about the influence of international and institutional developments on labor incomes. The articles have two points of departure. One focuses on technology, international transactions, and workers' skills. The other highlights the effects of domestic institutions—regulations, government employment policies, unions, and political structures—on the labor market.

This introductory article surveys some of the important issues for both current policy and future work. Section I discusses issues relating to international transactions, technology, and skills. Section II discusses the role of domestic institutions and regulations in an internationally integrated environment. Section III concludes.

I. Inequality, Technology, and International Transactions

The fear that development goes hand in hand with increased inequality—the so-called Kuznets curve—has until recently consistently been rejected by careful empirical evidence (see, for example, Little 1982; Deininger and Squire 1996; and Bruno, Ravallion, and Squire 1996). Indeed, it has become more common in development circles to argue that development can be equalizing. For example, World Bank (1993) shows a positive link between growth and more equal income distribution in East Asia. In addition, others have also argued that and have presented empirical evidence supporting the claim that (a reasonable degree of) equality is good for development (Alesina and Rodrik 1994; Perrson

and Tabellini 1995). We are concerned here with an alternative view: that some dimensions of inequality are rising and that this may be associated with aspects of international integration—through trade in goods, flows of capital, or migration—and with technological change.

Many economists believe that as countries become more open to trade, inequality falls in relatively poor countries with abundant unskilled labor and rises in their richer trade partners. This view—developed by Krueger (1978 and 1983) and more recently by Wood (1994)—makes perfect Heckscher-Ohlin sense. It also seems consistent with a set of stylized observations: (a) that as they became more open to external exchange, most industrial countries have suffered an adverse shock to the relative demand for unskilled labor in the past twenty years (Wood 1994); (b) that over the same period, inequality fell in the fast-growing, export-oriented Asian countries (Wood 1994); and (c) that during the globalization episode that also took place in the late nineteenth century, inequality fell in the labor-abundant countries of the Old World and rose in the resource-rich countries of the New World (Williamson 1996).

International migration and flows of capital potentially also affect wage inequality in poorer economies. Outmigration tends to tighten local labor markets, and the inflow of capital raises the real wage and hastens the labor market transition to industrial and service-based work. Although the poorest workers generally do not migrate, and even capital associated with unskilled work may directly employ only workers with basic education, virtuous cycles tend to develop, with international flows helping to equalize growth. With respect to the late nineteenth century, Williamson (1996) finds that migration was more important than trade in explaining rising inequality in the New World and falling inequality in those parts of the Old World that were rapidly integrating.

In trying to understand the empirical evidence, it is important to take into consideration changes in the relative supply of different categories of workers, since this also influences labor market outcomes. To the extent development is associated with increased education, the return to skills should fall on this account. For societies starting with low levels of education, the expansion of skills plays a powerful equalizing role. Indeed, in the United States, the rising relative supply of educated workers underpinned the "great compression" of relative wages that occurred in the 1940s and masked the disequalizing shifts in demand until about the mid-1970s (Goldin and Margo 1991; Katz and Murphy 1992). In a recent study of the Korean experience (Kim and Topel 1995), a large expansion in the relative supply of education was associated with a large decline in wage inequality. The study also reveals the mechanisms whereby sharply changing structures of labor demand translated into declining inequality in an initially agrarian society. The growth of manufacturing was accompanied by a wholesale shift of employment out of agriculture. The manufacturing sector attracted new entrants to the labor force: young educated urbanites, who stayed in this sector throughout their careers while older workers moved directly from rural areas and agriculture into cities and service employment.

New Views

Recent literature has raised the possibility that international interactions generate rising inequality, using frames of reference other than the Heckscher-Ohlin model. Most of the work in this new literature focuses on experiences in industrial countries. In the United States and the United Kingdom, the already large inequality in earnings has grown throughout the 1980s and 1990s (OECD 1996). By contrast, most other industrial countries have had small changes, with slightly equalizing trends in the 1990s in some, including Canada, Germany, and Japan.

In most industrial countries, unemployment rates among unskilled workers have doubled or tripled since the 1970s. Many analysts have argued that where relative wages have not been allowed to adjust, as in Europe, adverse shifts in demand have caused particularly severe rises in unskilled unemployment owing to sclerotic labor markets (Krugman 1995; Freeman 1995). But Nickell (1996), for example, points out that Norway, with a sclerotic labor market, has less unskilled unemployment than the United States, with a flexible one, and that the United Kingdom, with a flexible labor market, has higher unskilled unemployment than most other European economies. He concludes that labor market institutions explain only part of the differential unemployment performance and suggests that countries with low unemployment have better-educated unskilled workers.

Although the reality in rich countries is complex, most observers start from the view that there have been adverse relative demand shifts against unskilled labor. One debate about the reasons behind this has been couched in terms of trade versus technology. The most influential writings on this score are perhaps those of Wood (1994), Krugman and Lawrence (1993), Lawrence and Slaughter (1993), and Leamer (1995). Another debate focuses on free versus controlled migration; here, the more convincing arguments are perhaps those of Bhagwati (1991) and Borjas and Freeman (1993). Most analysts accept that trade, technology, and migration all matter, with important country-specific variations (see World Bank 1995b).

New evidence from some developing countries also indicates a rise in inequality. A series of recent studies has shown that income and wage inequality has risen in Mexico in the last decade (Feenstra and Hanson 1994; Revenga 1994). Pissarides (this issue) and especially Wood (this issue) survey recent evidence from several countries. As Wood stresses, these recent results are in sharp contrast with earlier studies that show, mainly in the Asian context, equalizing growth strongly related to the opening of trade and expanding supply of skills in Hong Kong, Korea, Singapore, and Taiwan (China) in the 1960s and 1970s. Either rising wage inequality or rising income inequality has been observed in the mid-1970s to early 1980s in Argentina and Chile; in the mid-1980s to early 1990s in Colombia, Costa Rica, and Mexico; by the end of the 1980s in Egypt and Jordan; and recently in China, Hong Kong, and Thailand. The evidence of

rising inequality is based largely on household surveys; the Mexican studies, using enterprise surveys, also find rising inequality between production and nonproduction workers.

Almost all developing economies have experienced rapid changes in the relative supply of skills. Robbins (1996a) attempts to disentangle supply and demand shifts, building on the work in the United States. In a series of nine case studies (Argentina, Chile, Colombia, Costa Rica, Malaysia, Mexico, the Philippines, Taiwan (China), and Uruguay), he concludes that underlying shifts in demand almost always increase inequality, although in some cases these are masked by large equalizing shifts in relative supply. Robbins further argues that the disequalizing changes in demand are often associated with trade liberalization and, in particular, the skill-intensive requirements of contemporary trade.

Tan and Batra (this issue) present a microeconomic story that is consistent with these trends. They use evidence from firms in Colombia, Mexico, and Taiwan (China) to study firms' decisions with respect to capital investment, training, and exports. They also investigate the effect of those decisions on labor productivity, wages, and wage differentials. The results are both striking and intuitively appealing. Productivity and wages rise with all of these decisions, but, although all workers gain from in-firm training (workers appropriate about two-thirds of the productivity gains), white-collar workers and other workers already possessing high skills gain much more than blue-collar workers. The premium that skilled workers receive in firms undergoing technological change compared with the premium they receive in firms not investing in training are surprisingly large: 42 percent in Colombia, 54 percent in Mexico, and 32 percent in Taiwan (China). The comparable premiums for unskilled workers are positive but small (22, 11, and 7 percent, respectively). Unskilled workers appear to gain relatively little from the introduction of new technologies, while the productivity of skilled workers rises quite dramatically. This is strong evidence that technological change favors skilled workers.

Trade, Migration, and Technology

As Wood (this issue) argues, the new observations are consistent with some of the old explanations. The trade and migration arguments are likely to apply to the middle-income developing countries where disequalizing trends have been observed recently. The technology arguments, in contrast, are likely to apply to all countries.

In his view the trade argument relates not only to changing patterns of protection, but also to increased competition from new entrants to the global markets—China and India, which have huge reservoirs of cheap unskilled labor. With the takeoff of these countries' exports since the early 1980s, unskilled wages could have been depressed globally, especially in middle-income countries that produce competing goods. In a general equilibrium model that disaggregates skill levels, we found that middle-income countries, especially those in Latin America, were hurt by the entry of low-wage countries into world exports

(World Bank 1995a). In addition, evidence links the deterioration in the commodity terms of trade, which has hurt African countries in the past three decades, to efficiency-improving methods introduced in East Asian countries.

International labor mobility can also cause rising inequalities in middle-income countries. Inequality is much larger internationally than in any one country—the international Gini coefficient is close to 0.70 but is substantially less than that in national settings—and has been rising steadily (Berry, Bourguignon, and Morisson 1989). Even though labor mobility has not risen in recent times in global terms, its nature has changed, and it now increasingly involves unskilled workers moving into middle-income and rich economies (Borjas and Freeman 1993). For example, Borjas and Freeman estimate that migration displaces unskilled workers in the United States at least as much as do imports from developing countries. Indeed, competition for jobs from migrants is more direct.

The trade and technology arguments are, at some level of abstraction, tough to disentangle because technical change is itself partly driven by increased competition (see Wood 1994). Increased openness to trade itself exacerbates the influence of new technologies, because trade liberalization induces more imitation, makes reverse engineering easier, and makes complementary imports cheaper. Increased openness also increases competition, thereby increasing the incentives to imitate. Pissarides (this issue) reviews the evidence on this.

But unlike the trade explanation, the technology story may well affect poorer countries, which tend to copy new technologies, even when they are not appropriate for their needs. As the richer North leaps ahead in education in order to escape competition from cheap labor, new technologies could increase inequality in poor countries, and the process of globalization could leave behind an increasingly large part of the world.

There also seems to be something new about the current globalization. Recent years have witnessed an acceleration of change. The recent demise of communism and end of the cold war, the conclusion of the Uruguay Round, the initiation of peace in South Africa and the Middle East, faster integration in Europe, Asia, and the Americas, and the seeming acceleration in technological change in the communication industry all have led to faster change in the patterns of production and trade. In an environment of global change, Pissarides argues that the returns to skills must rise because skills facilitate the adaptation to newness. This argument applies well to Eastern Europe, China, India, and even Latin America, where the recent wave of liberalization was sudden compared with the relatively slow and deliberate changes that occurred in East Asia.

In periods of change, skills become especially valuable, because they are needed to acquire and put in place new technology. Micro-evidence presented by Foster, Rosenzweig, and the Rural Indian Economic Growth Research Group (1996) for India shows how the returns to schooling rose significantly during the green revolution. The new, high-yielding seed varieties were potentially much more

productive than the traditional seeds, but significantly more sensitive to the use of such inputs as water and fertilizer. Because farming profitability depended so critically on the allocation of inputs, the ability to decode information became more valuable. In the states most affected by the green revolution (such as the Punjab), the profit differential between educated and uneducated farmers—with a focus on primary education—was as high as 40 percent.

Accepting such a view on the relationship between change and inequality, the recent rise in inequality in a number of economies could be temporary. If change slows—for example, as the consequences of opening work their way through an economy—inequality will fall.

The Role of Capital Mobility

Capital movements from rich to poor economies pull down wages in the former and pull up wages in the latter. But these effects are small relative to total investment levels in industrial countries and have clearly not offset global trends of divergence between countries (Pritchett 1995; World Bank 1995b). Capital movements amplify existing international and national trends. Countries with good domestic investment environments attract mobile international capital. Foreign direct investment frequently follows where other firms have previously gone—as found in one study of Japanese foreign direct investment (Kinoshita and Mody forthcoming). Within East Asia, for example, Japanese foreign direct investment and increased flows of investment from Hong Kong, Korea, Singapore, and Taiwan (China) have facilitated huge shifts in the international structure of production in the past two decades.

Within countries, the effects of capital inflows may equalize or disequalize wages, depending on the nature of shifting production structures. Inflows of foreign direct investment into labor-intensive production appear to have accelerated, leading to equalizing absorption of surplus unskilled labor into industry in countries such as Bangladesh, Malaysia, and Mauritius. But foreign capital can be relatively intensive in skills. Feenstra and Hanson (1994) argue that, with a range of production technologies, the marginal activity that moves from, say, the United States to Mexico will have factor proportions that are intensive in unskilled labor, compared with relative labor supplies in the United States, but intensive in skilled labor, compared with relative labor supplies in Mexico. These effects could increase inequality in both places.

Policies That Directly Affect Wage Differentials

In some countries, in addition to the effects of derived demand and relative supplies, direct policies affect wage differentials. A potentially important force leading to rising wage or income differentials is the recent demise of state efforts to influence the workings of labor markets. Whether through central planning or regulation, state intervention in setting wages and work conditions has been strong in large parts of the world but is now receding everywhere. Typically, such intervention, coming from a socialist and egalitarian background, has led

to compressed wage schedules. The reversal of such policies restores returns to education to a normal level.[1]

In some cases, a policy of subsidized education as the primary means of social mobility has exacerbated labor market policies. Assaad (this issue) describes this phenomenon in Egypt. In this case, and in other countries in the Middle East and North Africa, inequality increasingly results from falling demand for a certain type of skill. Reforms put new kinds of skills at an advantage and can effectively reverse past educational policies. Similarly, labor market reforms in economies that successfully held up the wages of low-paid workers can lead to wage decompression, as appears to have occurred in Chile in the 1970s and Italy in the 1990s (see Robbins 1996b on Chile and OECD 1996 on Italy).

In the end, whatever the deep reasons for the current wave of inequality, how societies respond to change will determine its effects. An optimistic view is that new technologies are cheaper than the old ones, capital is increasingly mobile, and the possibility of leap-frogging into modernity is increasingly open to flexible societies ready to attract and apply new technologies to production. Therefore, temporary inequality could buy a lot of growth. But this result depends on both the skills and the institutions of the society and, in particular, on how the education system, training in new technologies, and the interface between labor and firms adapt to new circumstances. Whether the new inequality will persist and rise, or fall rapidly, will ultimately depend on how societies organize their labor market, education, and production-related institutions.

II. Institutions and Outcomes for Workers

Labor market institutions affect the determination of wages and inequality. Will they matter less as reliance on domestic and international markets rises, capital becomes mobile, and technological change requires more "flexible" and shifting labor? We argue that institutions are crucial determinants of the consequences of market-driven change for workers. Institutions can influence both the extent to which economies participate in global advance and the extent to which different groups of workers within a country participate in national advance. However, many existing institutional arrangements in developing and transition economies are moribund. The issue is institutional reform, not institutional destruction.

Formal institutions affecting the labor market evolved historically in response to two pressures. First, the development of formal labor contracts in modern firms led to the creation of a legal and institutional framework for employer-worker relations.[2] Second, societies and workers wanted certain workplace rights,

1. A normal level would be a ratio of average wages of workers with secondary education to average wages of workers with primary education of 4–5. A ratio of 2–3 would reflect wage compression.

2. We treat the formal sector as including the portion of employment with some form of formal labor contract. The usual proxy for informal employment is nonwage employment (including family workers) plus wage employment in very small establishments. Clearly, there will be some purely casual employment in large firms and some effectively formal relationships in small firms.

conditions of work, and income security. Some of these demands also apply to informal contracts, and there is widespread evidence of complex contractual arrangements, in rural labor markets in particular, that evolved in response to the problems of managing risk and providing incentives for work when monitoring is imperfect. Here we are concerned with formal institutions.

Job Creation in Protected or Public Sectors

In the past few decades, the predominant employment model in both centrally planned and most developing countries has been the creation of formal sector jobs in industry, supplemented by government jobs to varying degrees. In developing economies with a protectionist labor market, this model provided "good" jobs to only a few workers. It failed to develop a modern sector responsive to the needs of the market economy and fostered labor market dualism. The core mechanism involved the creation of rents in protected or public sectors for a limited number of workers who obtained access to good jobs. Implicit or direct taxation of other sectors financed the rents.

Egypt provides a clear example of the power of institutions to affect labor demand and supply, with potentially severe long-term effects. The policy mix for most of the past thirty years involved a combination of protectionist industrialization, educational expansion, and public sector employment expansion—with a job guarantee for secondary and tertiary graduates. As Assaad (this issue) shows, this led to severe job rationing and queuing. Even with the sharp drop in public sector wages since the 1980s, there is still an implicit premium on government jobs—especially for women, who suffer less discrimination in the public than in the private sector. The premium on government jobs interacted with the education system to produce an excess supply of the wrong kinds of skills, with significant compression of wage differentials for skills.

The employment strategy also failed under central planning, but with a very different dynamic. In Eastern Europe and the former Soviet Union, massive creation of "good" jobs, especially in industry, was accompanied by widespread job security provisions. But this turned out to be a chimera. Many good jobs quickly became bad when subject to the market test, and the legacy of cradle-to-grave income protection remains a major fiscal problem. Moreover, even when the jobs were there, they were neither noted for healthy working conditions nor for industrial democracy. By contrast, central planning in China did not lead to the hugely accelerated employment shifts of the Soviet Bloc. In 1978, at the inception of China's transition from central planning, some 80 percent of the employment was still in agriculture. This has greatly eased employment aspects of the subsequent transition (Sachs and Woo 1994; World Bank 1996b). However, the "modern" jobs that were created in government and the state enterprise sector receive a much higher degree of income protection and social benefits than in market developing economies. These are only beginning to be disentangled in the mid-1990s in the current phase of reform.

Effects of Protective Labor Market Policy

Many analysts believe that protective labor market policy contributes to poor economic and employment performance, in both rich and poor economies although actual evidence is sparse (see OECD 1994 for industrial countries). Freeman's (1993) review did not find general evidence in support of the view that labor regulations had significant economic costs, nor did a set of case studies of labor in the adjustment process (Horton, Kanbur, and Mazumdar 1994). A cross-country analysis of Latin America by Rama (1995a) did find that a synthetic index of labor market distortions reduced growth by about half a percentage point (after controlling for other factors), but most of this appears to be associated with unionization and perhaps with public employment as opposed to regulations.

One interpretation of these results is that labor market regulations that go against the market fail. Squire and Suthiwart-Narueput (this issue) model the incentives to evade and avoid distorting labor market regulations, using minimum-wage law as an example. They show that where regulations are binding, compliance is characteristically low, especially (but not only) in developing countries. They also show that once compliance is endogenized, there is likely to be an upper limit to efficiency losses. And such binding regulations tend to be in protected sectors—public and industrial. Here the better conditions are a form of rent-sharing. In the public sector, a labor cost-raising regulation may actually bring choices closer to an efficient solution, to the extent that it offsets a tendency toward excess employment.

Where unions have some degree of independence, their influence often appears to be negative for overall economic and employment performance. Freeman and Medoff (1984) discuss the contrast between the monopoly aspects of union behavior and the potentially productivity-raising gains from unions giving a voice to workers. Rama (1995b) and Standing (1992) provide evidence that unionized sectors experience relatively slow employment growth. Rama estimates that in Jamaica, employment in highly unionized sectors grew 2 to 5 percentage points slower than other sectors in 1986–93. Standing estimates that in Malaysia, employment in sectors with industrial unions grew 5 percentage points slower than sectors without unions or with plant-level unions.

Unions have often been resistant to needed economic reforms—whether in Indian trade liberalization or in Latin American public sector reform. Devarajan, Ghanem, and Thierfelder (this issue) illustrate the potential importance of understanding union behavior in modeling economic change. They use Bangladesh as an example of a small but powerful unionized sector in protected industries. Exploring the effects of alternative assumptions on union behavior, including the option of unions bargaining simultaneously over employment and wages, as in the McDonald-Solow model, they find potential additional benefits of disprotection through trade liberalization when unions are present. Their results show that unions can matter but that the additional gains from liberalization are based on reducing the rents to union members.

Labor Policy and Institutions

At first glance, recent history looks gloomy for labor policy and institutions. One conclusion of the failure of employment strategy in countries with high levels of protection or central planning might be that labor policy needs to be deregulated. A superficial interpretation of East Asia's extraordinary success in both growth and modern sector employment creation is that it shows the advantages of flexible, unregulated labor markets. We argue the opposite here. Indeed, rising international integration adds to the case for reform of some labor regulations. Overall, however, three trends in international labor markets highlight the growing need for effective institutional arrangements for labor in much of the world:

- The secular rise of modern wage work in all regions except industrial countries and the former Soviet Bloc
- Increased domestic and international demands for stronger workplace rights, including freedom of association and better working conditions
- The declining efficacy of informal mechanisms for dealing with working conditions and income security as populations become more urbanized and work becomes more formalized.

Politics will continue to matter crucially for institutional choices. But the view that repression of labor institutions is necessary to get favorable results for employment and wage outcomes is debatable. Banerji and Ghanem (this issue) explore the empirical relationships between measures of political and civil liberties and both trade and labor market outcomes. They find that on average more liberal regimes are associated with more open trading and less labor market dualism. Authoritarian East Asian countries are the exception.

It is also a mistake to interpret East Asia's success in terms of a flexible, regulation- and union-free, neoclassical economist's ideal. In fact, countries in East Asia have had diverse labor arrangements. Unions have been severely restricted in Korea (especially in the period preceding democracy) but have extensive rights in Hong Kong and Japan (see Freeman 1993; World Bank 1996a). Korea has highly pervasive labor regulations, notably on job security, and an extensive government presence in areas that in many countries would be subject to collective bargaining. State enterprise workers in China have unparalleled levels of protection and are extraordinarily immobile by international standards. East Asian countries are often characterized as having a cultural tradition of reliance on the family (see, for example, Rohwer 1995). But the elderly in Japan are living less with their families than before, and the richer newly industrialized countries, including Korea, Malaysia, and Singapore, all have significant expanding forms of formal social insurance.

An important rationale for unions is that flexible arrangements for production organization and information flow yield potential productivity benefits that could be on the rise with more sophisticated technologies. However, these benefits—as opposed to the potential monopoly effects of unions—are more

likely to be reaped with a predominantly firm-based form of industrial relations within competitive product markets (see World Bank 1995b; Pencavel 1991 and 1995). Unions also have other important benefits, including protecting individual workers from abuse, monitoring health and safety regulations, and reducing gender and ethnic discrimination. For example, MacIsaac and Rama (1996) find that the significant discrimination experienced by women and indigenous employees in Ecuador disappears for union members; Patrinos (1994) finds comparable results for Mexico. Women tend to be over-represented (compared to the private sector) in the well-protected public sectors of Egypt and Jordan (Assaad, this issue; World Bank 1995b). Unfortunately, carefully documented research on both productivity and other effects is still rare in developing countries. Thus, policy will have to proceed with some uncertainty, creating conditions for unions to operate, reforming areas where monopolistic practices are probable (especially in the public sector), and not expecting unions to be able to solve all labor's problems.

Where does this leave labor regulations? Despite the weak evidence, a highly differentiated view is desirable at this juncture. Guarantees of rights for unions are desirable, but not monopoly privileges. Measures to protect the vulnerable are important, but not widespread mandates on working conditions. Public action to reduce income insecurity is clearly justified, but the design of interventions is crucial. In addition, the functioning of education and training systems will have a powerful complementary effect on labor market performance. Although government intervention remains of central importance in this sector, here, too, the form of this intervention is now the subject of many debates. Although it goes beyond the scope of this introduction to review this area, solving the quality problems that affect many developing-country school systems will be critical to producing school leavers with the wherewithal to acquire changing skills during the course of their working lives.

III. Conclusion

Increased trade linkages, mobile capital, and technological change are raising new questions over the attainment of old employment objectives. Debates in rich countries on insecurity of work and unemployment of unskilled workers find strong echoes in recent evidence from some developing and transition countries. As the articles in this issue illustrate, many of the debates are still current. They involve questions of how to achieve reasonable degrees of equity, satisfactory workplace conditions, and income security in the face of apparently rising market pressures. These debates also raise fundamental questions concerning the role of institutions that affect labor market outcomes, although evidence on the effects of alternative institutional arrangements is particularly scarce.

The answer is not institutional destruction. Societies that successfully put in place effective institutions are more likely to capture international gains. Three

areas of institutional innovation are likely to be central in the coming years: workplace organizational forms, formal mechanisms for the management of household risks, and education and training systems. These innovations are likely to be complementary: the greatest payoff will come from action in all three areas together. And it is likely that future research will have a rich payoff in this central domain for households and economies.

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Learning by Trading and the Returns to Human Capital in Developing Countries

Christopher A. Pissarides

Recent evidence shows that the returns to labor and the skill premium both increase in developing countries after trade liberalization, despite the low skill content of their exports. The author explains this apparent puzzle by arguing that trade increases technology transfers from industrial to developing countries and that the transfer technology is biased in favor of skilled labor. The relative demand for skilled labor increases during the transition following liberalization, and so the gains enjoyed by skilled labor are temporary, even in the absence of supply responses. The gains become longer lasting when the transferred technology is also skill-biased.

Several recent studies have found that trade liberalization in developing countries is often associated with a large increase in the returns to labor and with an increase in wage inequality. The increase in the returns to labor should come as no surprise: labor should receive at least some of the benefits from trade. The increased differential between the wages of skilled and unskilled labor, however, is more puzzling. According to the conventional and largely substantiated view of North-South trade, the industrial "North" exports high-quality goods to the developing "South," which exports primary products or lower-technology goods to the North. Trade liberalization in a developing economy should therefore be associated with an increase in the relative demand for unskilled labor and a narrowing of wage differentials.

This article discusses a channel through which the effects of trade liberalization are transmitted to the labor market and explains why both labor returns and wage inequality can increase after liberalization. According to this view, developing economies (the South) advance by learning from the technology of industrial economies (the North). Learning is faster when trade

Christopher A. Pissarides is with the Centre for Economic Performance at the London School of Economics. This article is a revised version of part of his background paper for *World Development Report 1995: Workers in an Integrating World,* which circulated under the title "Trade Liberalization and the Returns to Human Capital in Developing Countries." The author is grateful to Michael Walton and the staff of the World Development Report office for pointing out the puzzle, for offering their comments, and for making available unpublished information on labor returns in developing countries. The author also benefited from discussions with Tony Venables, Mary Amiti, Donald Robbins, Andrew Oswald (who suggested the title), and seminar participants at the Centre for Economic Performance, Warwick University; University of California, Los Angeles; the World Bank; and the Organization for Economic Cooperation and Development.

links the economies of North and South, so trade liberalization in a developing country leads to more technology transfers from the North to the South. Technology transfers can take place either through the production in the South of capital goods that are already in use in the North or through the importation of capital goods from the North. Results are independent of the method of technology transfer.

The key assumption is that the transfer of technology requires skilled labor. When a developing economy liberalizes trade, it experiences more technology transfers than before. Learning about the new technology and putting it to use in the South increase the demand for skilled labor, whose wages rise over and above any rise accruing to all kinds of labor from more production. But as the South learns the new technology, the pace of transfer slows, and the benefits to labor that remain are derived entirely from the production technology. If the transferred production technology is neutral, the relative advantage that skilled labor enjoyed during the learning process ceases. Thus, with a neutral production technology, a temporary increase in the relative demand for skilled labor causes the relative advantage of skilled over unskilled labor. With a skill-biased transferred production technology, the relative increase in the demand for skilled labor can be permanent.

Some recent literature supports the idea that more trade brings about more technology transfers. Coe, Helpman, and Hoffmaister (1995) find that the research and development (R&D) spillovers from the industrial countries to the developing countries are substantial. Total factor productivity in developing countries was positively associated with R&D expenditure abroad. More important here, however, the spillovers were linked to trade flows between the industrial and developing countries. The spillover from an industrial country to a developing country was proportional to the share of the industrial country's imports in the developing country's gross domestic product.

The empirical papers cited in section I, in particular Robbins (1994, 1995b) and Hanson and Harrison (1994), identify technology transfers as the most likely reason for the increase in wage inequality. Also, Wood (1995), in a recent evaluation of the widening of wage differentials, concludes that the transfer of technology is only one of two plausible explanations for the widening (the other one being the increase in the supply of low-technology goods in world markets because of the expansion of Chinese exports).

Section I discusses the recent evidence and explains why the widening of differentials is a puzzle in light of the recent widening of wage differentials in the labor markets of the industrial world. Section II explains the main idea of learning and technology transfers. Section III formalizes the learning process. Section IV describes and solves the full model. Section V considers the adjustments that follow trade liberalization and presents the main findings of this article. Section VI briefly considers other factors that might play a role in the relation between trade liberalization and wage differentials. Section VII contains some concluding remarks.

I. The Returns to Human Capital after Trade Liberalization

The most convincing evidence supporting the widening of wage differentials after trade liberalization comes from middle-income countries in Latin America and East Asia. In each case reviewed here, other reforms took place alongside trade liberalization, so other factors might have caused the widening of differentials. But in all cases the widening of differentials followed a large increase in trade flows. As the number of cases where trade liberalization and widening of differentials are observed concurrently increases, the link between the two will gain more support.

Robbins (1994, 1995b) examines data for Chile and Colombia. For Chile, he examines household survey data for 1957–92 to see if there were any marked changes in the earnings structure after trade liberalization took place beginning in 1975. He finds that although the skill composition of imports exceeded that of exports, skilled labor did not suffer a relative drop in earnings after trade liberalization. The returns to skilled labor increased by more than conventional trade theory would predict and also by more than changes in labor supply would predict. He concludes that the most likely explanation for the observed changes was the importation of capital that was complementary to skilled labor. Robbins finds a similar situation in Colombia. Using household data for Bogotá for 1976–89, he examines the response of wage differentials to the large rise in exports after the 1984 devaluation. He finds that wage inequality increased and attributes this to changes in the composition of the demand for labor that are induced by trade.

Pessino (1995) finds similar results for Argentina after 1990, also using household data. However, trade does not play an important part in her analysis, so it is not clear whether the widening of differentials could be attributed to trade. In more recent work, Robbins (1995a) examines household data for Argentina, Costa Rica, the Philippines, and Taiwan (China) and also finds similar results. Trade liberalization increased the relative demand for skilled labor in virtually all cases.

Hanson and Harrison (1994) examine plant-level data for 1984–90 in Mexico, where trade liberalization took place beginning in 1985. They find that wage inequality increased after liberalization, despite the relatively low skill content of Mexico's exports. They conclude that the most likely cause of the rise in wage inequality was the importation of skill-biased technology from abroad.

Tan and Batra (1995) present another set of related data. They do not explicitly look at the implications of trade liberalization; rather they calculate the wage premium paid by firms that engaged in R&D, worker training, and export activities in Colombia, Mexico, and Taiwan (China). Using firm-level data and controlling for other firm characteristics, they find that firms that engaged in technology-advancing activities paid all their workers a premium over and above the wages paid by other firms but that the premium paid to skilled workers far exceeded that paid to unskilled workers. Although the direct contribution of exports was less important than that of R&D and worker training, Tan and

Batra claim that trade liberalization increased the R&D activities of firms and the demand for skilled labor. They do not explore the links between trade involvement and technology-advancing activities at the level of the firm.

The experience of developing countries with wage inequality reflects the experience of industrial countries, which started somewhat earlier. A well-documented fact is that beginning sometime in the mid-1970s, the industrial world experienced a negative shock at the unskilled end of the labor market, which intensified in the 1980s. Despite growth in the economy overall, the wage and employment prospects of unskilled labor suffered relative to those of skilled labor and in some cases absolutely as well. The shock in labor markets of industrial countries did not have the same implications everywhere. It caused real wage reductions for unskilled labor in the United States and high unemployment in the major European economies, but what is more important here is the source of the shock. One view claims that trade with low-wage economies caused the shock in industrial countries. If this is true, however, the relative wages of unskilled labor in developing economies that opened up to trade would have *risen*, not fallen. The data summarized in this section contradict this view.[1] In another view, skill-biased technological progress caused the shock in industrial countries. Recent technological advances, such as computerization, require more skilled labor than the technologies they are replacing. As new investment crowds out unskilled labor, its wages relative to those of skilled labor fall.

The technology transfers modeled in this article cause more wage inequality in developing countries because the *transfer* technology is biased in favor of skilled labor. If the transferred production technology is also biased in favor of skilled labor, the inequality is reinforced. The skill-biased technology that comes into operation because of trade causes more wage inequality. So the implication for the debate of "trade versus technology" is that neither trade nor technology alone causes inequality; rather both act together. My approach does not contradict the existence of Hecksher-Ohlin effects on wage differentials. Instead, it disputes the view that the Hecksher-Ohlin effects on wages dominate in the transition from steady state in a semiclosed economy to steady state in an open one.

II. Trade and Learning

In this section, I follow recent literature and assume that technological improvements result from activities that use skilled labor as an input. I refer to these activities as R&D (or, when the reference is explicitly to developing countries, as imitation). I interpret R&D broadly to include all activities that lead to new discoveries, as well as imitation and assimilation activities that lead to the adoption of products or techniques known elsewhere.

1. Wood (1995), who in earlier work claimed that the widening of wage differentials in the industrial North was associated with trade, claims that the widening of wage differentials associated with trade growth in developing countries is a recent phenomenon. In the early 1970s there was some evidence that wage differentials narrowed in southern European countries that liberalized trade.

A firm producing with the most advanced known technology can improve its productivity only by undertaking R&D aimed at new discovery. This is likely to be the cause of technological change in the more advanced countries. But producers in less advanced countries are not likely to be using the most advanced known technology. For them, it is cheaper to copy other firms' technologies than to attempt to make new discoveries. Imitation has a higher probability of success than R&D aimed at an original discovery: learning from the mistakes of others is cheaper than learning from one's own. (See Tan and Batra 1995 for a summary of some case studies that find that technological progress in developing countries is achieved through imitation.) Given the low-wage advantage that developing countries enjoy, if a firm in a developing country succeeds in imitating a production process implemented by firms in a richer trading partner, it is also likely to succeed in selling its product to the more advanced country.

Trade induces more imitation in a developing country by giving its producers several types of incentives to learn fast the technology of the North. First, trade between two countries exposes producers in each to the capital equipment and techniques used in the other. Trade increases the probability that imitation in the South will succeed because the traded goods embody the transfer of information about new products and techniques. Nelson (1970) makes a related distinction between "experience" and "inspection" goods. In general, producers in developing countries might be aware that producers in other countries use superior techniques or that producers elsewhere produce better varieties of goods. But producers in developing countries that are exposed to the superior goods through trade are more likely to imitate those products and techniques.

Second, even with a given probability of successful imitation, the competition from trading partners increases the firm's incentives to innovate. The trading partners enter the market with superior goods, which can drive domestically produced goods out of the market. This occurs regardless of whether firms in the South move from monopolistic to competitive conditions, which may or may not increase R&D activities. Producers in the South have more incentives to imitate the superior technology of the North, in order to be able to compete with newcomers, retain their domestic market share, and export to markets in the North.

Third, after trade liberalization, the developing country can import more capital and other intermediate goods from the North. In this case, the R&D technology should be interpreted as a learning-how-to-use technology, rather than as a learning-how-to-produce technology. This interpretation is consistent with the plausible assumption that skilled labor is needed to show the rest of the workforce how to put imported capital goods into productive use.

These ideas imply that when a developing country liberalizes trade, it devotes more resources to imitating the technology of its trading partners and participates in more technological transfers. But how well does the available international R&D data for developing countries measure this broad concept of R&D? It is a well-documented fact that R&D activities are heavily concentrated in a

few industrial countries and that developing countries undertake very few of them (see, for example, Coe and Helpman 1995 and Coe, Helpman, and Hoffmaister 1995). Nevertheless, a first potential test of the ideas presented here is whether trade liberalization is associated with more R&D, however narrow its empirical definition. In an empirical analysis, imitation in the context discussed here should be interpreted broadly to include all new production activities in the South that are influenced by the exposure of its economy to that of the North.

III. A Formalization of the Learning Technology

In this section, I formalize the idea of a technological transfer by assuming that the speed of learning depends on the difference between the knowledge of producers in a country and the knowledge of its trading partners. Trade liberalization leads to more technology transfers because it enlarges the set of technological innovations that become known to producers in developing countries.

I measure the state of technology by the number of capital varieties in existence (Romer 1990). Capital varieties are differentiated but not necessarily superior to one another. Here, I look for a symmetric equilibrium with the same quantity of each known variety of capital. More capital varieties lead to more total factor productivity because each variety has diminishing returns to scale. This assumption gives the same results for the returns to human capital as the alternative assumption of improvements in the quality of capital goods, which provides another appealing way of measuring the state of technology (Grossman and Helpman 1991b).

Borrowing ideas from Grossman and Helpman (1991a), I assume that the level of technology in the North improves through original expensive research and that a lower level of technology in the South improves through cheaper imitation of the North's technology. To simplify the analysis, I assume that the level of technology in the North is independent of the activities of firms in the South. In addition, because the economy of the North is not of interest in this analysis, I simplify further by assuming that the technology of the North improves at exogenous rate g.

In the South, producers engage in R&D to discover ways either to imitate the innovations used elsewhere or to learn how to use imported machinery. In order to write an equation for the learning technology, I denote the number of varieties of known capital goods in the North by A. Of these, the South already uses several varieties, B. B can never exceed A, and normally it is strictly less than A. Following Rivera-Batiz and Romer (1991), I assume that the production technology uses three factors of production—unskilled labor, denoted L; human capital (or skill), denoted H; and all the varieties of the capital goods known in the economy. In contrast, the more skill-intensive imitation technology activity uses only human capital as an input.

The number of varieties of capital goods increases according to the learning technology, which depends on the input of human capital and on the number of varieties of capital at home and abroad. I write the learning technology in the South as

$$\dot{B} = \lambda H_B \Phi(B, A - B) \tag{1}$$

where B has already been defined as the number of varieties of capital goods already copied (the stock of knowledge in the developing economy), λ is a constant, H_B is the stock of human capital employed in the imitation process, and $\Phi(B, A - B)$ is a homogeneous function, increasing in both its arguments, and concave.

The function $\Phi(.)$ is the main new element in the model and the key to the results. Two features are important. First, imitating the technology of the North is a skill-biased activity in that it uses skilled labor (human capital) but not unskilled labor. The fact that no unskilled labor or capital is used in imitation is a simplification. What is important is that, relative to the production technology, more human capital and less unskilled labor are used in R&D.

Second, the function $\Phi(.)$ captures the idea that learning is easier when there is already a lot of knowledge and also when there is more knowledge to acquire. Thus, holding constant the stock of knowledge in the developing country, exposure to more knowledge abroad raises the speed of learning at home for given inputs into R&D. For convenience, I assume that at $A = B$; that is, when there are no more capital varieties to be copied, $\Phi = B$. This and the other technical assumptions on $\Phi(.)$ imply that

$$\Phi(B, A - B) = \Phi(1, A/B - 1)\, B \equiv \phi(A/B)B. \tag{2}$$

$\phi(.)$ increases in its argument at a decreasing rate and satisfies $\phi(1) = 1$.

Using equation 2, equation 1 becomes

$$\frac{\dot{B}}{B} = \lambda\phi(A/B)H_B. \tag{3}$$

Equation 3 gives the rate of technological progress in the economy of the developing country, which, with fixed labor supply, in the steady state is also the rate of growth of aggregate output. The function $\phi(A/B)$ represents the advantage of the imitator over the inventor. If $A = B$, $\phi = 1$ and equation 3 can be interpreted as a process of discovery. But with $A > B$, which will always be the case if the economy of the South is less technologically advanced than the economy of the North, $\phi > 1$ and imitation is cheaper (that is, more productive for a given human capital input) than original discovery.

IV. Growth Equilibrium

Equilibrium is described by the evolution of capital varieties, B, given an arbitrary initial value, market-clearing prices for the three factors of production, and the allocation of human capital between production and imitation. I assume a constant supply of each type of labor in order to isolate the effects of trade liberalization that work through the demand for labor. (The implications of variable supply are discussed briefly in section VI.) Factors are fully employed, and the allocation of human capital between its two uses is at the point where marginal returns in each use are equal.

The consumption side of the model is not specified, so the model does not need to include trade flows. I assume instead that output is divided between final consumption and capital and obtain equilibrium output and capital stock from the market-clearing conditions in factor markets. In order to do that, I next specify the production technology.

The production technology uses the three factors of production—the known varieties of capital, human capital, and unskilled labor—to produce output that is subsequently sold in competitive markets at a unit price (the numeraire). To avoid integer problems, suppose that the capital varieties lie on a continuous line and that the representative production unit employs $x(i)$ units of each capital variety i. The production function is

$$Y = H_Y^{\alpha} L^{\beta} \int_0^B x(i)^{1-\alpha-\beta} \mathrm{d}i \tag{4}$$

where Y denotes output, H_Y denotes the human capital used in the production of goods, L denotes the unskilled labor input, and α and β are positive parameters that sum to a number less than 1.

Aggregate output Y is divided between consumption and investment in new capital goods. For exposition purposes, suppose that the property rights to each variety of capital are owned by a patent holder or by the single importer who first succeeded in imitating (or importing and adapting) the variety. The patent holder, a monopolist, then licenses this product to a manufacturer, who supplies it at a unit price to the patent holder. The patent holder decides how much of the capital variety to order on the basis of the price for selling it back to manufacturers. That price, the price of the capital variety, is denoted $p(i)$. Assuming for simplicity that capital fully depreciates after one period, $p(i)$ equals the static marginal product of $x(i)$,

$$p(i) = \frac{\partial Y}{\partial x(i)} = (1 - \alpha - \beta) H_Y^{\alpha} L^{\beta} x(i)^{-\alpha-\beta}. \tag{5}$$

Because the patent holder has to pay one unit price for each unit of capital goods, the per period profit accruing from the sale of the capital variety is $p(i)x(i) - x(i)$. The monopolist chooses the quantity of $x(i)$ supplied to maximize

profit, so the equilibrium quantity of each capital variety supplied maximizes the expression

$$p(i)x(i) - x(i) = (1-\alpha-\beta)H_Y^{\alpha}L^{\beta}x(i)^{1-\alpha-\beta} - x(i). \tag{6}$$

The maximization condition is

$$(1-\alpha-\beta)^2 H_Y^{\alpha}L^{\beta}x(i)^{-\alpha-\beta} - 1 = 0. \tag{7}$$

Equation 7 gives the equilibrium condition in the market for each capital variety i, given the inputs of the other factors of production.

Substitution of $x(i)$ from equation 7 into equation 5 gives the monopolist's price for the capital good:

$$p(i) = \frac{1}{1-\alpha-\beta} > 1. \tag{8}$$

The difference between the equilibrium price and the cost of capital, $p(i) - 1$, is the monopolist's profit from owning the patent for the capital variety.

Because the $x(i)$ that solves equation 7 and the $p(i)$ in equation 8 are independent of i, I can drop i and write x for the equilibrium quantity of each capital variety and p for the equilibrium price. It follows that the aggregate capital input into the production technology, the integral of all B varieties of $x(i)$, is simply Bx. The production function then becomes

$$Y = BH_Y^{\alpha}L^{\beta}x^{1-\alpha-\beta}. \tag{9}$$

Equilibrium in the market for unskilled labor, given the fixed labor supply L, gives the solution for the unskilled wage. The marginal product of labor is obtained from equation 9 and is equated to the unskilled wage, w_L, to give

$$\beta BH_Y^{\alpha}L^{\beta-1}x^{1-\alpha-\beta} = w_L. \tag{10}$$

The allocation of human capital between the two activities—imitation and production—takes place such that the rewards to human capital in each are equalized. The rewards to human capital in production are equal to the marginal product of human capital, $\partial Y / \partial H_Y$. In the imitation technology, the profit from employing one more unit of human capital is the present discounted value of profit from the discovery, given by $[(px - x)\lambda\phi(A/B)B]/r$ for a constant discount rate r. Equating this expression with the marginal product of human capital in the production technology and making use of equation 7 to substitute out x give the solution for H_Y:

$$H_Y = \frac{\alpha r}{(\alpha+\beta)(1-\alpha-\beta)\lambda\phi(A/B)}. \tag{11}$$

The only remaining equation for full characterization of the solution is the one for the wages of skilled labor. This is obtained by differentiating the produc-

tion function with respect to human capital and equating the result to the wage rate:

$$\alpha B H_Y^{\alpha-1} L^{\beta} x^{1-\alpha-\beta} = w_H. \tag{12}$$

Equations 3, 7, 10, 11, and 12 are uniquely solved for the paths of B, x, H_Y, w_L, and w_H, given an initial value for B, labor supply L, and human capital supply H, where $H_B = H - H_Y$. The path of output can then be obtained from equation 9.

The steady state of the system is found by looking for a steady state for B. Because $\phi(.)$ is not a linear function, if A is growing at exogenous rate g, equation 3 implies that in the steady state B must grow at the same rate. Therefore, in the long run, the economies of both North and South must grow at the same rate (a result known since Krugman's 1979 pioneering paper), though obviously their income levels might differ. Substitution of the steady-state growth rate into equation 3 gives the steady-state relation between the level and rate of growth of technology and human capital:

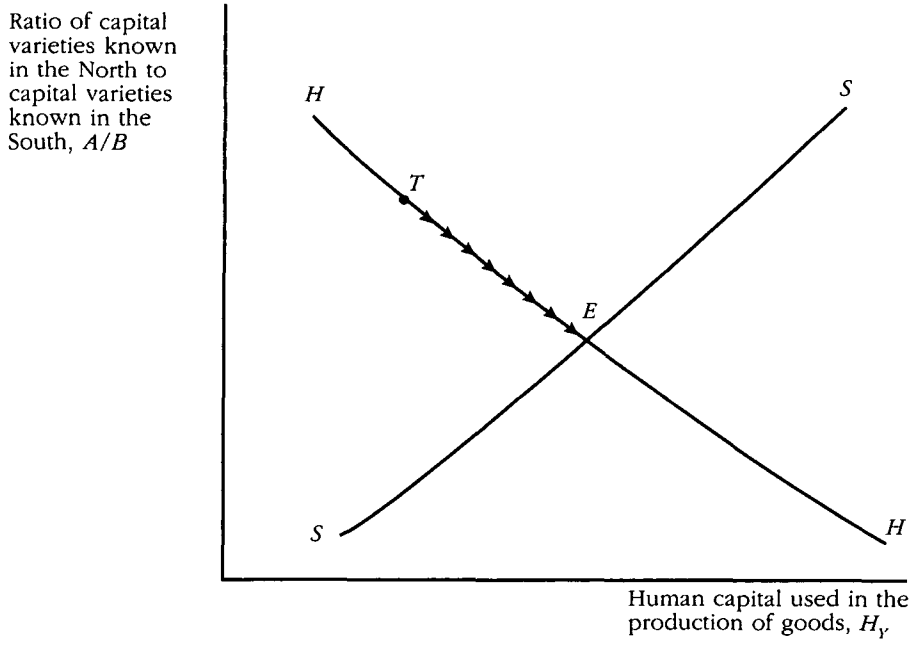
$$\lambda\phi(A/B)(H - H_Y) - g = 0. \tag{13}$$

I illustrate the solution with a simple diagram that is useful in the analysis of trade liberalization (section V). Equations 13 and 11 give unique solutions for H_Y and A/B, as illustrated in figure 1. The line HH is a representation of equation 11 and shows the condition under which the returns to human capital are equalized in the two activities in which human capital takes part. HH has a negative slope because a higher A/B makes imitation more rewarding, so the input of human capital into production falls. The line SS shows the steady-state condition of equal growth rates in the two economies (equation 13). SS slopes up because, for a given growth rate abroad, a higher A/B increases the domestic growth rate because it facilitates imitation. To maintain a constant growth rate requires switching human capital from imitation to production.

Under the simplifying assumption that human capital is perfectly (and instantaneously) mobile between production and imitation, the economy is always at some point on the HH line. That point is determined by the value of the exogenous variable A and the value of the predetermined variable B. Because equation 3 is a stable differential equation in B, the economy is always tending to the intersection of the two curves in figure 1 along HH, as shown by the arrows (ignore point T for the moment).

With knowledge of B and H_Y from figure 1, it is possible to obtain a unique solution for the path of x from equation 7, a unique solution for the path of output from equation 9, and unique solutions for the paths of wages from equations 10 and 12.

Figure 1. *Equilibrium with Technological Transfers*



V. Trade Liberalization

I now consider the influence of trade on the relative returns to skilled and unskilled labor. I first solve explicitly for the relative returns to skilled and unskilled labor by dividing equation 12 by equation 10 to get

$$\frac{w_H}{w_L} = \frac{\alpha}{\beta}\frac{L}{H_Y}. \tag{14}$$

Relative returns are independent of capital (or the state of technology) because, according to the Cobb-Douglas assumption, technology is neutral. Substitution of H_Y from equation 11 into equation 14 gives the relative returns to skilled and unskilled labor as

$$\frac{w_H}{w_L} = \frac{L(\alpha+\beta)(1-\alpha-\beta)\lambda}{\beta r}\phi(A/B). \tag{15}$$

The key result in equation 15 is that the higher the fraction of the technology of the North that the South has imitated, the lower the relative rate of return to human capital. This result occurs because the imitation technology uses human capital but not unskilled labor. Human capital enjoys an advan-

tage as long as there is still a lot of technology to imitate. But the more imitation that has already taken place, the less the advantage enjoyed by skilled labor.

As equation 15 shows, the only unknown influencing the relation between the returns to skilled and unskilled labor is the ratio A/B. I therefore analyze the influence of trade liberalization on relative returns with reference to figure 1.

Trade influences equilibrium in this model by enlarging the technology set that becomes known in the South. In the formal model this can be shown by an enlargement in set A. Looking at the steady-state equilibrium in figure 1, it is clear that set A does not influence relative equilibrium returns. It influences only the set B that is imitated in the South, because the solution for the ratio A/B is independent of A. Thus, in the steady state a country that trades has a higher *level* of technology and higher *absolute* returns to labor (from equations 10 and 12) than a country that trades less but has the same growth rate and the same relative returns to labor.

The results are different during the adjustment following liberalization. Suppose that trade liberalization is accompanied by a once-and-for-all rise in the set A that is known in the South. (Obviously, the increased knowledge will take place over time as foreign goods are experienced in the South, giving rise to more sluggish dynamic effects than the ones described here.) The effect of an increase in A is an increase in the rate of return to imitation. Producers in the South shift human resources out of production and into R&D. Because unskilled labor is not useful in the R&D technology, the relative returns to skilled labor rise immediately after trade liberalization. In figure 1, an increase in A for a given initial level of B shifts the (temporary) equilibrium to a point such as T. The relative return to human capital is higher at T because there has been an increase in the relative demand for it by firms engaged in R&D.

Both the increase in set A and the shift of human capital to R&D lead to the introduction of more capital varieties in the South and to an increase in the rate of growth of its economy. Eventually, the number of capital varieties copied increases sufficiently to restore the ratio of known varieties, A/B, to its pretrade level. At this point the advantage of skilled labor over unskilled labor evaporates, and human capital moves back to production, as the demand for it drops in the R&D sector. The rate of growth of the economy of the South at this point drops down to the rate of growth of the economy of the North. In the diagram, for as long as the economy is above point E, both the rate of growth of the economy of the South is higher than the rate of growth of the economy of the North and the relative demand for human capital is higher than it was previously. But when the economy reaches E, both values drop to their previous steady-state levels.

Thus, the relative gain that skilled labor receives from trade liberalization is temporary, even for a fixed supply of human capital and unskilled labor. Human capital in this formulation has a comparative advantage only during the transition to a higher steady state, which takes place after trade liberal-

ization. When the transition is complete, both human capital and unskilled labor gain from the opening up to trade, but relativities do not change.

VI. Caveats and Extensions

The increase in the relative demand for human capital after trade liberalization is temporary because the imported production technology is neutral; that is, the new varieties of capital copied in the South are not better complements for human capital than for unskilled labor. I briefly consider here three cases in which richer results could be obtained. In the first case, the imported technology is not neutral but is biased in favor of skilled labor. This is a plausible assumption to make, given the increase in the rate of return to human capital—largely attributed to new technology—that has taken place in industrial countries. If the capital varieties invented in the North are more complementary to skilled than to unskilled labor, then it is natural that the varieties copied in the South will bias productivities in favor of skilled labor.

If technology is biased in favor of skilled labor, the number of capital varieties B will enter the expression for relative wages, equation 14, with a positive sign.[2] Then, for given supplies, the increase in the technology set of the South that results from trade liberalization will lead to a permanent and ever-increasing gain in the relative rate of return to human capital. Such gains will mirror any gains to skilled labor in industrial countries.

Such a situation, however, cannot be a long-run steady state. Eventually, the relative supplies of factors will adjust endogenously in response to the higher rate of return to human capital. A new steady state will then be reached when the rise in the supply of human capital offsets exactly the increase in the relative demand for human capital that results from the biased technology. How long the gain to human capital will persist when the technology transfers are not neutral depends on the speed with which the supply of human capital catches up with the shift in relative demands.

In the second case, human capital might enjoy a more long-lasting increase in relative demand if the production of capital goods is more human capital-intensive than the production of consumption goods (see Keller 1994). In the model presented in this article, both consumption and capital goods are produced by the same technology. But if capital goods embody more up-to-date technology, it might be more reasonable to assume that there are two separate production sectors in the economy: one producing consumption goods and one producing capital goods. If the capital goods sector requires more human capital than the consumption sector, then the fact that foreign capital varieties are copied at a faster rate after trade liberalization is another reason why the relative demand for human capital will increase. Producers will shift human capital to the capital goods

2. I do not attempt to formalize this idea here, which can be done by replacing the Cobb-Douglas production function by a nested constant elasticity of substitution function, because of the additional complexity.

sector of the economy. Relative wages for skilled labor will then rise either until it becomes too expensive to copy any more capital varieties or until the domestic supply of human capital increases to offset the gains in relative wages.

The first two cases considered in this section share a common property. They both imply that the technology transferred to the South makes the aggregate production function more skill-biased than it was before the liberalization of trade. The correction mechanism is an increase in the relative supply of skilled labor. Another plausible supply response, however, is likely to reinforce the increase in the relative returns to human capital in the period immediately following trade liberalization, even if the liberalization shock is neutral.

It is common to think of developing countries as having a large potential supply of unskilled labor, which is either underemployed in agriculture or discouraged because of the lack of jobs and is waiting for an opportunity to enter formal employment. The response of this supply to a positive shock can be fast, certainly faster than the response of skilled labor, which needs to be trained. It follows that when trade liberalization increases the demand for both kinds of labor, the wages of skilled labor increase more than the wages of unskilled labor, because the initial rise in unskilled wages is checked by the response of the supply of unskilled labor. Eventually, however, the supply of educated labor catches up, restoring the wage differentials.

Thus, the third case for an increase in the relative wages of skilled labor occurs even without biased technology transfers because the supplies of the two types of labor respond differently to an increase in aggregate labor demand. As in the other cases considered in this section, the situation just described is not likely to be a long-run equilibrium. Eventually, labor will train in response to the higher rate of return to skill and the relative advantage of skilled labor will erode away. The length of time that skilled labor can maintain an advantage over unskilled labor for the reasons outlined here depends on the speed with which unskilled labor "migrates" to the skilled sector, through education and training, relative to the speed with which it responds to the higher demand for unskilled labor.

VII. Conclusions

The widening of the skilled-unskilled wage differential that has been observed in developing countries that have liberalized trade is not a puzzle. Trade acts as a channel for the transfer of technology from industrial to developing countries. In the formal model described and solved in this article, the technology imported from the North into a developing country is neutral. It gives a temporary advantage to skilled labor over unskilled labor because the importation and assimilation process needs the services of skilled labor. Trade liberalization moves the economy of the developing country on to a permanently higher level of technology, although its rate of growth in the new equilibrium is not likely to be higher than it was before liberalization.

Skilled labor enjoys a relative advantage during the transition to the higher-level technology, which is reflected in higher relative wages for the duration of the transition. Of course, if the imported technology is biased in favor of skilled labor, skilled labor gains a permanent increase in relative demand. The correction mechanism then is the increase in the supply of skilled labor to meet the higher demand.

The response of the relative supply of skilled and unskilled labor to the trade liberalization might also cause a temporary widening in wage differentials. The supply of unskilled labor in a developing country is likely to be more elastic in the short run than the supply of skilled labor because of the existence of underemployed workers in agriculture or discouraged rent seekers waiting for new job opportunities. If this is the case, any overall increase in labor demand associated with trade liberalization will have a larger short-run impact on the wages of skilled labor than on the wages of unskilled labor, until the supply of skilled labor also increases to match the higher demand.

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Openness and Wage Inequality in Developing Countries: The Latin American Challenge to East Asian Conventional Wisdom

Adrian Wood

The experience of East Asia in the 1960s and 1970s supports the theory that greater openness to trade tends to narrow the wage gap between skilled and unskilled workers in developing countries. In Latin America since the mid-1980s, however, increased openness has widened wage differentials. This conflict of evidence is probably not the result of differences between East Asia and Latin America. Instead, the conflict is probably the result of differences between the 1960s and the 1980s, specifically, the entry of China into the world market and, perhaps, the advent of new technology biased against unskilled workers.

According to conventional wisdom, greater openness to trade in developing countries not only increases efficiency but also reduces wage inequality. Openness boosts the relative demand for unskilled workers and hence narrows the gap in wages (and in unemployment rates) between unskilled and skilled workers. The experience of Latin America since the mid-1980s, however, has challenged this optimistic view. Greater openness to trade has been accompanied by rising rather than falling wage inequality. In contrast, the debate over trade and inequality in *developed* countries is now over the *magnitude* of the effects, with their *direction*—adverse to unskilled workers—being largely agreed (Wood 1995).

This article attempts to resolve the conflict of evidence in developing countries. Section I outlines the theory underlying the conventional wisdom. Section II provides an overview of the empirical evidence, both in favor of and against the conventional wisdom. Section III considers explanations of the conflict of evidence based on differences between East Asia and Latin America. Section IV

Adrian Wood is with the Institute of Development Studies at the University of Sussex. Financial support for the preparation of this article was provided by the U.K. Overseas Development Administration through its support of research at the Institute of Development Studies and by the World Bank. This article was originally prepared as a background paper for *World Development Report 1995: Workers in an Integrating World*. The author extends special thanks to Don Robbins, whose work motivated this article and who provided many unpublished papers and comments. The author acknowledges the valuable comments of Shahen Abrahamian, Riccardo Faini, Richard Freeman, Edward Leamer, Jörg Mayer, Patricio Meller, Jeffrey Sachs, Wolfgang Stolper, three anonymous referees, and participants in seminars at Harvard and the Massachusetts Institute of Technology, at conferences at the universities of Oxford, Reading, and the Auvergne (CERDI), and at a Centre for Economic Policy Research conference in La Coruña.

considers explanations based on differences between the 1960s and the 1980s. Section V sums up.

I. Heckscher-Ohlin Theory

The belief that increased openness reduces wage inequality in developing countries rests on an apparently indisputable fact—that the supply of unskilled labor, relative to the supply of skilled labor, is larger in developing than in developed countries (Wood 1994: table 3.1)—and on an often-disputed but widely used theory of trade—that of Heckscher and Ohlin.

The Simplest Model

Heckscher-Ohlin theory asserts that countries export goods that use intensively those factors of production that are relatively abundant at home and import goods that use intensively factors that are relatively scarce. Trade thus increases the demand for abundant factors, because of the expansion of export sectors, and reduces the demand for scarce factors, because of the contraction of import-competing sectors, with corresponding effects on factor prices. In developing countries, where unskilled labor is abundant and skilled labor is scarce, trade tends to raise unskilled wages and to lower skilled wages and hence to narrow the gap between them.

To explain the effect on relative wages more precisely, consider a simple model with two countries (developed and developing), two factors (skilled and unskilled labor), and two goods (skill-intensive machinery and labor-intensive clothing). The developing country has a relatively large supply of unskilled labor, giving it a comparative advantage in clothing, while the developed country has a relatively large supply of skilled labor, giving it a comparative advantage in machinery.

Barriers to trade (transport costs and tariffs, for example) drive wedges between the prices of goods in the two countries and may even result in no trade or autarky. In particular, the barriers keep the price of clothing lower in the developing country than in the developed country and have the opposite effect for machinery. A reduction in barriers, and the resulting expansion of trade, would thus raise the price of clothing and lower the price of machinery in the developing country.

Such a change in relative domestic producer prices would raise the wage of unskilled workers relative to that of skilled workers. This link, known as the Stolper-Samuelson theorem, exists because Heckscher-Ohlin theory assumes that technology (that is, the production function for each good) is given. In other words, it assumes a fixed functional relationship between outputs of goods and inputs of factors, which (with no excess profits) implies a similarly fixed relationship between the prices of goods and the wages of factors.

The outcome can be illustrated in a type of supply-and-demand-curve diagram adapted from Leamer (1995). In figure 1, the downward-sloping line, *dd*, is the demand curve for unskilled labor that would prevail in a state of autarky.

Figure 1. *Effects of Openness on Relative Wages: Two Traded Goods*

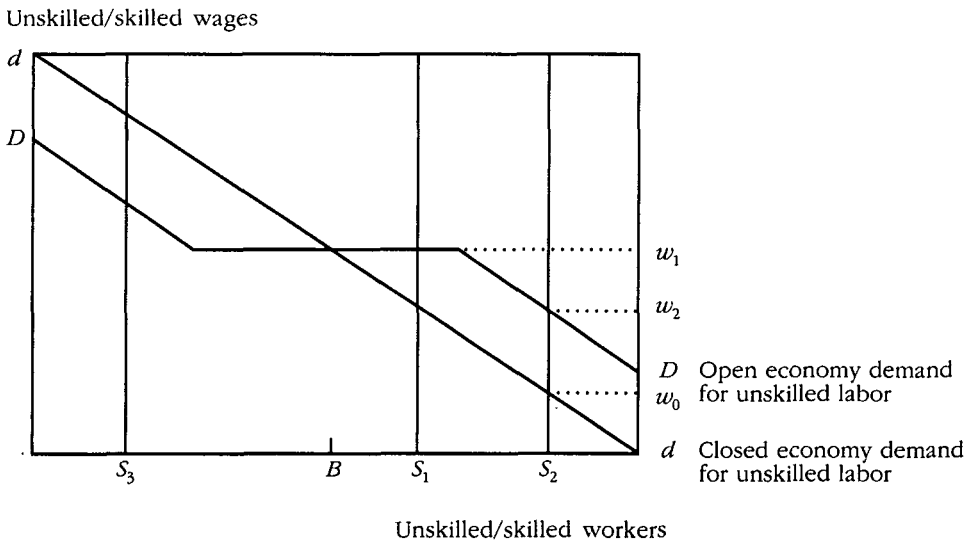
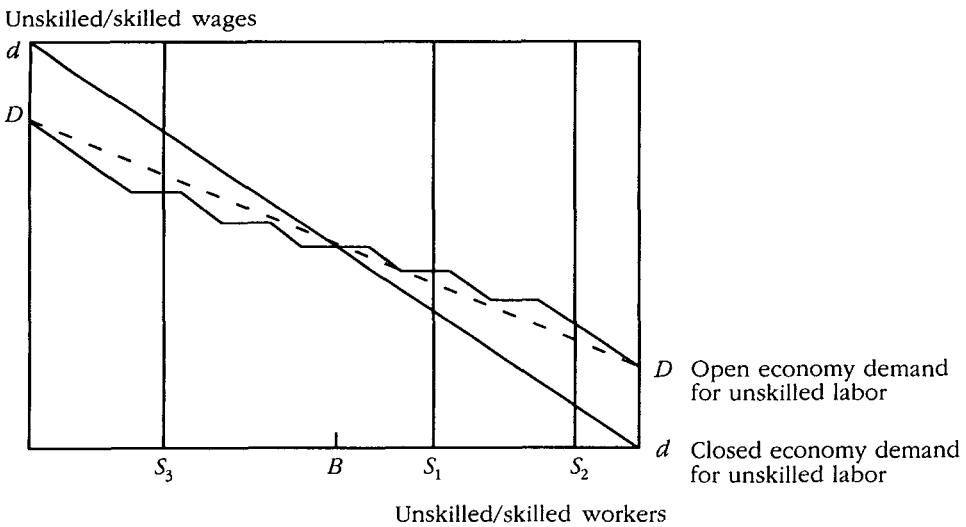


Figure 2. *Effects of Openness on Relative Wages: Many Traded Goods*



In the absence of trade, wages would be determined by the intersection of this demand curve with a supply curve (assumed for simplicity to be completely inelastic), whose position depends on the country's endowment of skilled and unskilled labor. With supply S_2, say, as in a country with many unskilled workers, the relative wage of unskilled labor would be at the low level, w_0.

The demand curve in a country open to trade is the line DD. It crosses dd at B on the horizontal axis: if it had this skill supply ratio, even an open country would not trade. The developing country, which has a relatively large supply of unskilled labor and hence is a net exporter of clothing, must lie to the right of B (and the developed country must lie to the left of B). So for a developing country, opening to trade shifts the demand curve in favor of unskilled labor (DD lies above dd) and narrows the gap in wages. With a skill supply ratio S_2, the relative wage of unskilled labor would rise from w_0 to w_2.

The open-economy demand curve DD is an odd shape, with two downward-sloping segments separated by a flat segment in the middle: even to the right of B, there are two distinct segments in the developing-country range. The flat segment covers the range of skill supplies in which a trading economy would be diversified, in the sense of continuing to produce both clothing and machinery (albeit in different proportions than under autarky), as for example in a developing country with skill supply S_1. But a country with a high proportion of unskilled workers, as at S_2, would not produce machinery; rather it would specialize in clothing (a country with very few unskilled workers, as at S_3, would specialize in machinery). Such specialization puts a country on a segment of the demand curve that slopes downward because increases in the relative supply of unskilled labor have to be absorbed by relative-wage-induced changes in the technique chosen to produce the single good.

Trade raises the relative wage of unskilled workers, whether the outcome is diversified or specialized. But the effects on wages of subsequent changes in the relative domestic supply of labor differ. In a diversified country (as at S_1), relative wages are fixed by relative world prices, at the level w_1. Changes in the domestic labor supply, unless they are big enough to affect world prices, do not change relative wages: they alter only the composition of output and trade. By contrast, in a specialized country on a downward-sloping segment of DD, as at S_2, changes in domestic labor supply do affect relative wages. For instance, an increase in the relative number of skilled workers would raise the relative wage of unskilled labor.

More Goods, Countries, and Factors

This model can be extended to include many goods (differentiated by skill intensity) and many countries (differentiated by skill supply) without fundamentally altering the conventional theory that a reduction in trade barriers has a beneficial effect on the relative wages of unskilled workers in developing countries. However, the inclusion of nontraded goods and additional factors can yield contrary results in special cases.

Consider a rise in the number of traded goods. Figure 2 is drawn on the same principles as figure 1, but with six rather than two goods (and at least six countries). The open-economy demand curve, *DD*, instead of having one flat segment, has five, which alternate with downward-sloping segments. Countries whose relative skill supplies put them on a flat segment produce two goods, adjacent in skill intensity, while those on a downward-sloping segment produce only one good. All countries are specialized, because none produces all of the goods, but in those that produce two goods, as in a fully diversified country, small changes in labor supplies do not alter relative wages. However, larger changes in labor supplies do alter relative wages by moving the country to a different segment of *DD*.

The effects of trade on relative wages remain the same as in figure 1. In developing countries, to the right of *B*, a reduction in trade barriers shifts demand in favor of unskilled labor and narrows the skill differential in wages. The impact on wages is bigger for countries with a relatively large supply of unskilled labor (that is, the further the country lies to the right of *B*). For countries with intermediate skill supplies, in the vicinity of *B*, trade has a smaller effect on wages and could either increase or decrease them. This is because trade causes the most and the least skill-intensive sectors to contract: such countries export goods of medium skill intensity and import goods of high and low skill intensity from countries with higher and lower relative supplies of skilled labor.

In reality, the number of traded goods of differing skill intensity is very large. It is thus reasonable, as well as convenient, to approximate *DD* by a continuous line (shown with dashes in figure 2). Dornbusch, Fischer, and Samuelson (1980) and Feenstra and Hanson (1995) present formal models that assume an infinity or continuum of traded goods. This multiple-goods formulation emphasizes two important points. First, in an open economy, the demand curve is more elastic than in a closed economy, so that changes in factor supplies have *smaller* effects on relative wages. Second, and contrary to the impression conveyed by the two-goods model in figure 1, even in an open economy, changes in factor supplies are generally likely to have *some* effect on relative wages.

Realism also requires the inclusion of nontraded goods in the model. The low ratios of trade to output in many "open" economies indicate that transport costs are often more important barriers to trade than tariffs and quotas. Nontraded goods do not necessarily alter the conventional theory of the effects of greater openness on relative wages, but they do create the possibility of "perverse" outcomes, arising from particular patterns of substitution in consumption between traded and nontraded goods.[1] Robinson and Thierfelder (1996) present a formal model in which the effect of changes in world prices on factor prices can be either normal or perverse, depending on the elasticity of substitution in consumption.

Consider, for example, a country with an abundant supply of unskilled labor in which labor-intensive nontraded goods are close substitutes for the more skill-

1. Edward Leamer suggested this possibility.

intensive of two traded goods. Greater openness reduces the price of the more skill-intensive traded good, inducing consumers to buy more of it and less of the nontraded good. The resulting drop in demand for unskilled labor in the nontraded sector might more than offset the rise in demand for unskilled labor in the traded sector, leading to a fall rather than a rise in the relative wage of unskilled workers.

Perverse outcomes are also possible (though by no means inevitable) when the model is extended to include more factors than skilled and unskilled labor. Consider, for example, infrastructure, a third factor that complements skilled labor in production. In principle a country might have a low ratio of skilled to unskilled labor, but a large supply of infrastructure and hence a comparative advantage in infrastructure-intensive traded goods. In such a country, greater openness to trade would increase the output of infrastructure-intensive goods, which also require a high ratio of skilled to unskilled labor and could thus raise the demand for (and the wages of) skilled relative to unskilled workers.

II. Overview of the Empirical Evidence

This section summarizes the factor content of trade and time-series studies that support the conventional wisdom about the effects of greater openness on relative wages in developing countries. Two other types of supporting evidence are neglected here (but are covered in Wood 1994: 220–27): cross-country studies, which are scarce, and simulation studies, which are vulnerable to disagreements about specification. This section also summarizes the recent time-series studies that challenge this conventional wisdom. The conflict of evidence thereby exposed provides the focus for the rest of the article.

Factor Content of Trade Studies

Studies of the factor content of trade calculate the amounts of skilled and unskilled labor used to produce a country's exports and compare these with the amounts of skilled and unskilled labor that would be required to produce domestically the goods that the country imports. If the ratio of skilled to unskilled labor is lower for exports than for imports, then increased openness to trade—more exports, more imports, and less import-competing production—should raise the relative demand for (and so the relative wages of) unskilled workers. Moreover, most calculations of factor content underestimate the impact of trade on the relative demand for skilled and unskilled labor, because they fail to allow for noncompeting imports (Wood 1994: 72–74, 87–91, 121–26).

Table 1 encapsulates some relevant results from the classic study by Krueger and others (1981), which calculated the factor content of trade in broadly defined manufactures in a range of developing countries in the early 1970s. The table shows the ratio of the average skill intensity of exporting sectors to that of import-competing sectors, using two different measures of skill intensity. In every case, the ratio is less than unity, implying that exporting sectors are less skill-intensive than import-competing sectors, usually by a wide margin.

Table 1. *Skill Intensity of Trade in Manufactures in Selected Countries*

Country	Year	Ratio of average skill intensity of exporting sectors to that of import-competing sectors: Numbers measure[a]	Wages measure[b]
Brazil	1971–72	—	0.92[c]
Chile[d]	1966–68	—	0.26[e]
Colombia	1973	0.53[c]	0.60[f]
Côte d'Ivoire[d]	1972	0.62[c]	—
Hong Kong[d]	1973	0.51[c]	—
Indonesia	1971	0.55[c]	0.45[e]
Tunisia	1972	Less than 1[c]	0.65[c]
Uruguay	1968	0.49[f]	—
Unweighted average		0.54	0.58

— Not available.

a. Based on the ratio of skilled to unskilled employment. Skilled workers are white-collar, unskilled blue-collar, except in Hong Kong (where skilled workers are defined as professional) and Côte d'Ivoire and Tunisia (where some blue-collar workers are in the skilled category). For Tunisia, the source does not give the precise number of skilled workers.

b. Based on the average wage per worker; the precise nature of the calculation varies among the country studies.

c. Trade with all partners.

d. Includes home (nontraded) goods' indirect labor use.

e. Trade with industrial countries only.

f. Exports to industrial countries only, imports from all partners.

Source: Krueger and others (1981), Krueger (1983); for further details, see Wood (1994: table 3.2).

Fischer and Spinanger (1986, retabulated in Wood 1994: table 3.6) find the same result for twenty-one developing countries trading in manufactures with developed countries in 1965, 1973, and 1983: in sixty-one of the sixty-three cases, exports are less skill-intensive than imports. Similar results emerge for Taiwan around 1970 in Lee and Liang (1982: table 10.20), for India in the 1980s in Nambiar and Tadas (1994: table 10), and for several developing countries in Bourguignon and Morrisson (1989: 282). All these studies are limited to manufacturing, but Kim and Vorasopontaviporn (1989) show that, for Thailand, more trade would also increase the demand for low-wage agricultural labor.

Applying a somewhat different approach to three Latin American countries in 1970–85, Londero and Teitel (1996) compare the skill intensity of fast-growing manufactured exports with that of the manufacturing sector as a whole, using sectoral wage levels as their measure of skill intensity. As shown in table 2, all three countries export manufactures of low, medium, and high skill intensity. In Argentina and Colombia, products of medium and low skill intensity account for three-quarters or more of the exports (discounting the value shares for Colombia, which are heavily influenced by two specific products). But in Venezuela, products of high skill intensity account for 40–60 percent of the total.

The fact that almost all calculations of factor content in developing countries show exports to be less skill-intensive than imports is generally seen to support

Table 2. *Skill Intensity of Manufactured Exports in Argentina, Colombia, and Venezuela, 1970–85*

Country and skill intensity	*Percentage based on*	
	Number of products	*Value of exports*
Argentina		
High	25.0	18.0
Medium	52.1	53.6
Low	22.9	28.4
Colombia		
High	13.5	38.4
Medium	32.7	27.2
Low	53.8	34.4
Venezuela		
High	39.0	58.6
Medium	39.0	9.9
Low	22.0	31.5

Source: Londero and Teitel (1996: tables 5 and 6).

the conventional view that greater openness benefits unskilled workers in particular. However, analysts devote insufficient attention to variations among developing countries in the skill intensity of exports, which theory implies should be higher in better-educated (or middle-income) countries. And few analysts divide the imports of middle-income countries between those from higher-skilled trading partners and those from lower-skilled partners, which in theory should have different effects on the skill structure of domestic labor demand. The Krueger study is an honorable exception, but the pattern of world trade has changed significantly since the period to which it refers.

Studies that attempt to relate the movement of relative wages over time in particular countries to changes in trade barriers—sometimes casually, sometimes econometrically—provide an entirely different sort of evidence. Most such work has been done on countries in East Asia and Latin America; the results for the two regions are reviewed separately here, following a few remarks on methodology. The few studies of countries in other regions are severely limited by a lack of relevant data, for example, Bourguignon and Morrisson (1989) on Malawi and Morocco and Fontana (1994) on Ghana and Sri Lanka. There are also several studies of the impact of trade liberalization on unemployment (reviewed and extended by Edwards and Edwards 1995), but they rarely distinguish between skilled and unskilled workers and are mainly concerned with transitional dislocation rather than with enduring changes in the labor market.

Methodology

All time-series studies encounter serious problems in the measurement of skill differentials in wages. The common division between white-collar (nonproduction) and blue-collar (production) workers is treacherous, because the skill composition of both groups changes over time (for example, fewer clerks and more engineers in the white-collar category). Data on wages by level of education are

more satisfactory, but not always available. Nor is it easy to obtain accurate measures of changes in openness: information on trade barriers, particularly on the restrictiveness of nontariff barriers, is often inadequate, and changes in the ratio of exports or imports to gross domestic product (GDP) are an unreliable proxy. To measure the impact of changes in openness, it is also necessary to control for changes in domestic influences on relative wages, especially changes in the relative supply of skilled and unskilled labor and changes in labor market institutions that increase or reduce wage flexibility (but also changes in the supply of factors that complement skilled or unskilled labor, in the composition of demand, and in cyclical forces).

CHANGES IN THE RELATIVE SUPPLY OF SKILLED AND UNSKILLED LABOR. As is clear from figures 1 and 2, the impact on relative wages of increased openness (a shift of demand from *dd* to *DD*) varies with the level of supply of unskilled labor (the position of the vertical line *S*). The observed change in wages does not accurately measure the impact if increased openness coincides with a shift in supply. This measurement problem would be less serious if *DD* were infinitely elastic over the relevant range: the observed change in wages would be an accurate measure of the impact of increased openness at the *initial* level of supply (though not at the *final* level of supply, where the closed-economy wage would have been different). But if *DD* is less than infinitely elastic, the change in wages does not accurately measure the impact of increased openness even at the initial level of supply.

Robbins (for example, 1995a) uses two methods to isolate the effects of supply shifts in developing countries. His first method, the inner product test, asks whether relative wages and relative employment in the various skill categories moved in *opposite* directions (implying that supply shifts dominated) or in the *same* direction (implying that demand shifts dominated). In addition, to test the Heckscher-Ohlin prediction that changes in openness affect relative wages by altering the composition of output, Robbins decomposes changes in the skill structure of employment into between-industry and within-industry (between-occupation) components. However, this decomposition is vulnerable to the high level of aggregation of industries in most of his data because changes in product mix can occur *within* statistically defined industries.

Robbins's second method of controlling for changes in supply is to estimate time series of implied shifts in the relative demand for skilled and unskilled labor, using information on relative wages and an equation of the form

$$(\hat{d}_1/\hat{d}_2) = \sigma(\hat{w}_1/\hat{w}_2) + (\hat{s}_1/\hat{s}_2) \tag{1}$$

where d and s are demand and supply, the subscripts 1 and 2 denote skilled and unskilled labor, σ is the elasticity of the relative demand curve, and ^ over a variable indicates a logarithm. Equation 1 is fundamentally an accounting identity, but, if an assumption is made about the value of σ, it can be used to deduce shifts in demand from observed changes in supply and wages. Attempts to use

this method are complicated by the fact that the absolute value of σ is likely to become larger (and perhaps infinite) as a result of increased openness. Robbins (1995b) thus experiments with different values of σ. He also shows that even in apparently open economies, relative wages are inversely related to relative supply (with the significant exception of Taiwan after 1978), which supports the view that *DD* is usually less than infinitely elastic.

CHANGES IN LABOR MARKET INSTITUTIONS THAT INCREASE OR REDUCE WAGE FLEXIBILITY. Changes in government policies might affect relative wages by altering legal minimum wages, the rights and powers of unions, or the extent of employment in the public sector (where wage differentials tend to be narrower than in the private sector). For example, even if demand and supply tend to narrow the wage gap between skilled and unskilled workers, the gap might widen because of a decline in the minimum wage. Thus, changes in wage flexibility affect the accuracy of calculations based on equation 1 and more generally make it harder to measure the impact of changes in openness. In principle, using data on unemployment rates by skill level can solve this problem (because the *combination* of changes in relative wages and relative unemployment rates should indicate the direction of demand and supply shifts), but in practice such data are rarely available.

East Asia

Most of the time-series evidence from this region refers to the four tigers (Hong Kong, the Republic of Korea, Singapore, and Taiwan). Analysts always cite the experience of the four tigers as confirmation that greater openness raises the relative demand for unskilled workers. In fact, this evidence, reviewed in more detail in Wood (1994: 228–43), is by no means as clear-cut as commonly supposed. The data on relative wages contain gaps and deficiencies. In addition, few analyses have attempted to control for internal influences on the movement of relative wages.

Nonetheless, most of the evidence supports the conventional view that the adoption of more outward-oriented policies increases the demand for workers with only a basic general education relative to the demand for workers with more education and skills. The evidence is also consistent with the theoretical prediction that a switch in trade regime causes a step (or once-and-for-all) change in the composition of demand, whose effects on skill differentials in wages appear to be spread over a period of about ten years. In three of the four tigers, the gap in wages between skilled and unskilled workers narrowed during the decade in question (the 1960s in Korea and Taiwan, the 1970s in Singapore). In Hong Kong in the 1950s (where the change in trade regime was rather different), the wage gap widened, but this was probably the result of a simultaneous, large increase in the relative supply of unskilled labor.

Expansion of post-basic education is another possible explanation for the narrowing of skill differentials in wages. However, in all three of the cases in

which differentials narrowed, the change in trade regime appears to have been at least partly responsible—either because the narrowing was faster than in adjacent decades or because the expansion of higher education was deliberately restrained during the period concerned. After the initial decades of export-oriented industrialization, the expansion of higher education further compressed wage differentials in all four economies (albeit with periods of widening wage differentials, which occurred for a variety of reasons). For more details on the experiences of the four tigers in the 1970s and 1980s, see also Fields (1994) and Robbins and Zveglich (1995).

There is less evidence for other countries in East Asia. Robbins (1994a) finds persistent compression of wage differentials by level of education in Malaysia from 1973 to 1989, particularly between university graduates and less-educated workers. This continued in the early 1990s, with skilled and semiskilled blue-collar workers in manufacturing gaining relative to other groups. Robbins, arguing that this was not a case of increased openness, ascribes this compression mainly to the relative growth in the number of highly educated workers (the inner product test shows that supply shifts dominated demand shifts), perhaps augmented by the policy of discrimination toward indigenous Malays. However, his data show that demand shifted in favor of less-skilled workers within industries, perhaps because of trade-related changes in product mix—the expansion of export-oriented labor-intensive activities within the textiles and machinery sectors. These two sectors account for a big and rising share of all employment—up from 13 percent in 1984 to 16 percent in 1989 (Robbins 1994a: table 22). Moreover, between 1984 and 1989, the share of university-educated workers declined in textiles and was static in machinery, despite growth in the relative supply of such workers (Robbins 1994a: tables 1–3, 15; see also the information on Malaysia in Bourguignon and Morrisson 1989: 116–17).

Robbins (1994b) also analyzes movements in wages by education level in the Philippines between 1978 and 1988, a period of modest trade liberalization accompanied by a severe recession in 1982–86. Skill differentials in wages show no clear trend: they widened during the recession but then narrowed again. The initial, remarkably large relative supply of university graduates increased somewhat, but inner product tests yield conflicting results about the relative importance of demand and supply pressures on relative wages.

Latin America

Other studies by Robbins cover Argentina, Chile, Colombia, Costa Rica, and Uruguay. Table 3 summarizes the results for seven periods in which efforts were made to increase openness by lowering tariffs, easing quantitative import restrictions, or devaluing the currency (which, in the presence of quantitative restrictions, reduces antiexport bias by lowering the "quota premia" on—or tariff equivalents of—these restrictions). In Argentina in 1989–93, there was little if any net increase in openness, because the reduction of barriers was offset by appreciation of the exchange rate. It also seems unlikely that openness increased

Table 3. *Effects of Increased Openness in Five Latin American Countries*

Country and years	*Changes in trade regime*	*Skill differentials in wages*	*Predominant influence (inner product test)*	*Relative demand for skill (time series)*
Argentina (Buenos Aires)				
1976–82	Barrier reduction with appreciation	Widened	Demand	Rising
1989–93	Barrier reduction with appreciation	Narrowed	Supply	Falling
Chile (Santiago)				
1974–79	Barrier reduction with devaluation	Widened	Demand	Rising
1984–92	Devaluation	Fluctuated	Demand	Rising
Colombia (seven cities) 1985–94	Devaluation to 1989, barrier reduction in 1990–92	Widened	Demand	Rising
Costa Rica 1985–93	Barrier reduction and devaluation	Widened	Supply, except in 1988–90	Rising
Uruguay (Montevideo) 1990–95	Barrier reduction	Widened	Demand	Rising

Source: For Argentina, Robbins, Gonzales, and Menendez (1995); for Chile, Robbins (1995a); for Colombia, Robbins (1996a); for Costa Rica, Robbins and Gindling (1997); for Uruguay and various other countries, Robbins (1995b, 1996b).

in Chile during 1984–92, despite a large devaluation, because by that time almost no quantitative restrictions were placed on imports.

In all the five remaining periods (one in each country) in which openness did increase, skill differentials in wages (by level of education) widened, contrary to the conventional wisdom. The widening occurred from the mid-1970s to the early 1980s in Argentina and Chile and between the mid-1980s and the mid-1990s in Colombia, Costa Rica, and Uruguay. In all five cases, the relative number of skilled workers was rising, and thus the dominant influence on the change in wages was a rise in demand (as indicated by the results of the inner product tests, except for part of the period in Costa Rica). The time-series calculations (based on equation 1) confirm that the relative demand for skilled labor rose in all five of these episodes.

Mexico is another Latin American country where skill differentials in wages widened after the mid-1980s in parallel with radical liberalization of the trade regime. The wage gap between nonproduction and production workers in manufacturing widened between 1984 and 1990 (Feenstra and Hanson 1995; Hanson and Harrison 1995; Revenga and Montenegro 1995). Robbins (1996b) corroborates this finding for wage differentials by level of education over the period 1987–93 and shows, by controlling for changes in relative supply, that the driving force was a shift in relative demand.

In some of these countries, liberalization of labor market institutions might explain the widening of skill differentials, but this possibility is rejected by the

authors of these studies. Robbins (1996b) finds no correlation in Chile, Colombia, or Costa Rica between movements in relative wages (or in his relative demand time series) and changes in the legal minimum wage. (By contrast, Bell 1995 finds that minimum wages do have an effect in Colombia, but her study focuses on average rather than relative wages and ends earlier.) Robbins also argues that reduced union power is unlikely to have been the cause, with the possible exception of Argentina. In Mexico, the widening of skill differentials during 1984–90 coincided with a steep decline in the real minimum wage, but Feenstra and Hanson (1995) and Hanson and Harrison (1995) reject this explanation, citing Bell (1995), who finds that even in 1984 the average production worker was paid more than the minimum in 97 percent of the manufacturing plants in the data set.

These rejections are not entirely convincing. In particular, the widening of wage differentials in Chile in the late 1970s, following the military overthrow of the Allende government, did coincide with a severe curtailment of union activity (Edwards and Edwards 1995) and, moreover, simply restored differentials to the levels prevailing in the late 1960s (Robbins 1995a: figure 5). The widening of wage differentials in Argentina in the late 1970s also occurred after a military coup and in parallel, as Robbins points out, with a decline in the union movement. The counter-evidence for Mexico also needs to be treated with caution: because wages vary among production workers, the legal minimum wage could affect the average wage even if it set only the lowest wage (well below the average). Moreover, Bell (1995) finds that the legal minimum wage did affect the wages of many workers in the informal sector.

Assessment of the Time-Series Evidence

All the time-series studies—both those that support and those that contradict the conventional wisdom that increased openness reduces wage inequality in developing countries—are open to doubts of one sort or another. But it is hard to avoid the conclusion that there is a genuine conflict of evidence: in some countries and periods, increased openness does appear to have caused a narrowing of skill differentials, but in others the opposite seems to have happened (even allowing for influences other than trade).

The conflict is particularly sharp between, on the one hand, the evidence from East Asia in the 1960s (Korea and Taiwan) and 1970s (Singapore and probably Malaysia) and, on the other hand, the evidence from Latin America in the late 1980s and early 1990s. Increased openness was also associated with widening wage differentials in Argentina and Chile in the late 1970s, but in both these cases labor market liberalization under military rule is a plausible alternative explanation. It is harder to explain away the rise in wage inequality in Colombia, Costa Rica, Mexico, and Uruguay since the mid-1980s.

For the rest of this article, I assume that there was a genuine difference between the effects of greater openness on wage inequality in East Asia in the 1960s and 1970s and its effects in Latin America in the late 1980s and early

1990s. Nonetheless, I acknowledge the various residual doubts and the need for further research on the countries concerned, which might erase the apparent conflict. My assumption not only allows the following pages to focus on possible reasons for the difference but also suggests a convenient framework for the discussion. The conflict involves two regions in two periods: the next section thus asks whether it might be caused by *differences between East Asia and Latin America*, and the following section asks whether it might be caused by *differences between the 1960s–70s and the 1980s–90s*.

III. Differences between East Asia and Latin America

Some important differences between the two regions have already been taken into account in the preceding review of evidence: the much faster growth in the supply of skilled labor in East Asia and the more regulated nature of labor markets in most Latin American countries. This section examines two other possibly important areas of differences: the availability of natural resources and the choice of policy instruments for increasing openness.

Natural Resource Endowments

In some respects, East Asia and Latin America are similarly endowed: both are well educated by comparison with Africa and South Asia, and both have fairly well-developed infrastructure. However, Latin America is far better endowed with natural resources than East Asia and consequently has a comparative advantage in primary products (including processed products, such as canned fish). By contrast, East Asia's comparative advantage lies in narrowly defined manufactures (such as clothing) that require few inputs of local natural resources. The difference in comparative advantage is clear from data on land per worker in the two regions and on the composition of their exports (Owens and Wood 1995: figures 6 and 7). The difference is also clear from the sectoral pattern of the output response to increases in openness. In East Asia, the growth of exports was concentrated in manufacturing. In Latin America, the gains were mainly in primary and processed primary exports, with other (nonprimary processing) manufacturing often shrinking, except in the parts of Mexico adjacent to the United States.

As explained in section I, the introduction of a third factor, such as land, into the Heckscher-Ohlin model could in principle cause greater openness to widen wage differentials even in a country with a relatively low ratio of skilled to unskilled labor. For Latin America, the mechanism would have to be that skill and natural resources were complementary inputs, so that the expansion of primary output raised the relative demand for skilled labor. In practice, however, primary production is not generally skill-intensive, in comparison with import-competing manufacturing. Mining and oil refining do require a highly skilled labor force but account for only a small share of total employment. Agriculture, a far larger employer, has a low ratio of skilled to

unskilled workers.[2] And most primary processing is not skill-intensive. Except for Hong Kong, most of the manufactured exports in Krueger's factor content study (summarized in table 1) were processed primary products (as defined in Owens and Wood 1995). Londero and Teitel (1996: table 5) show that, in Argentina and Colombia, only 13 percent of manufactures intensive in natural resources are of high skill intensity, and in Venezuela, only 30 percent are. The cross-country regressions in Owens and Wood (1995) suggest that primary processing needs a literate labor force but uses a smaller proportion of highly skilled workers than other sorts of manufacturing.

It remains possible that some more complicated process, involving nontraded sectors as well as natural resources, could explain the difference in wage outcomes between the two regions.[3] For instance, it might be the case that all manufactures were import substitutes in Latin America, but only skill-intensive manufactures were import substitutes in East Asia. In that case, nontraded sectors (of a given absolute skill intensity) might be *more* skill-intensive than import-competing sectors in Latin America and *less* skill-intensive than import-competing sectors in East Asia. Hence, if greater openness (through substitution in consumption) caused nontraded as well as export sectors to expand (and import-competing sectors to contract), the net effect might be to increase the relative demand for skilled labor in Latin America, but to decrease it in East Asia.

This specific chain of causation may seem far-fetched, but the correlation between the regional differences in natural resources and in wage outcomes is strong enough to warrant further empirical research. It might also be worth checking whether the wage data for Latin America are hiding increased demand for unskilled workers because of gaps in the coverage of primary sectors and rural areas. The data for Argentina, Chile, Colombia, and Uruguay cover only cities, and most of the data for Mexico are limited to manufacturing. However, the Costa Rican data, which show much the same wage pattern, are nationwide. Moreover, even in the other countries, the data include factory-based primary processing. And if labor markets work properly, changes in relative wages in sectors that are not covered by the surveys should be transmitted into the sectors that are covered.

Trade Policy Instruments

The opening to trade in East Asia, particularly in Korea and Taiwan in the 1960s, was achieved mainly by increasing incentives for exporters, while keeping fairly high levels of protection against imports in most sectors. Most of the opening to trade in Latin America, by contrast, involved large reductions in barriers to imports.

2. However, a referee suggested that in Latin America the least skill-intensive agricultural subsector, staple food, may be an import substitute, so that increased openness may raise the relative demand for skilled labor *within* agriculture.

3. Jeffrey Sachs suggested this.

From a macroeconomic viewpoint, the two approaches are equivalent: it does not matter whether bias against exporting is reduced by giving subsidies to exports or by lowering barriers to imports. However, because neither the subsidies nor the barriers are uniform across sectors, their effects on the sectoral structure of output, and so on the skill composition of the demand for labor, may be different. Labor-intensive manufacturing subsectors such as clothing and footwear were initially highly protected in most Latin American countries (as in developed countries), so that making barriers against manufactured imports lower and more uniform tended to hurt unskilled workers more than skilled workers. For example, in Chile in 1974, textiles and footwear were the second and third most protected manufacturing sectors, with effective rates of protection over 200 percent (Edwards and Edwards 1995: table 2). And in Mexico, Revenga and Montenegro (1995: table 2) show that the nominal tariff on apparel and footwear in 1985 was among the highest in manufacturing, although it stands out less in the calculations of Hanson and Harrison (1995: table 2).

The differences in trade regimes deserve further investigation (and comparison with the liberalization of imports in Korea and Taiwan after the mid-1980s), but this is not a promising explanation of the difference in wage outcomes between the two regions. If Latin America had a comparative advantage in unskilled labor-intensive goods, manufactured or primary, then the effects of import liberalization in sectors such as clothing and footwear should have been more than offset by the growth of exports in (these or other) labor-intensive sectors. And if in fact the outcome of increased openness was a rise in the relative demand for skilled workers because Latin America did *not* have a comparative advantage in unskilled labor-intensive sectors, the explanation must be sought somewhere other than in the details of its trade regime.

IV. Differences between the 1960s–70s and the 1980s–90s

This section examines the possibility that the observed difference in wage outcomes occurred because the world changed in some respect between the 1960s and 1970s, the period covered by the East Asian time-series studies, and the late 1980s and 1990s, the period covered by the most convincing Latin American evidence. One such change was the entry of the largest low-income countries into world markets in the 1980s. Another was perhaps a shift in the skill bias of technology. These two changes seem to be the most promising explanations in this category: others that seem less promising are the debt crisis and greater international mobility of labor and capital. However, Feenstra and Hanson (1995) present a model in which capital flows could explain the widening of wage differentials in Mexico.

Entry of Large Low-Income Exporters

Half the world's population, and an even higher proportion of the world's unskilled workers, live in five low-income Asian countries: Bangladesh, China,

India, Indonesia, and Pakistan. In the 1960s and 1970s, all five countries were largely closed to trade, and thus their workers did not form part of the effective world labor supply. By the mid-1980s, these countries were all opening to trade, led by Indonesia and China, with the South Asian countries also making some progress. Their manufactured exports grew rapidly: in the six years between 1987 and 1993, developed countries' imports of manufactures from low-income countries rose nearly four times, from $28 billion to $110 billion (about one-third of all manufactured imports from developing countries), while imports from middle-income countries rose less than 50 percent.[4]

This opening of the low-income half of the world is likely to have altered the comparative advantage of middle-income countries, whose ratio of skilled to unskilled workers is above the global average, though below that of developed countries. The economic world of the 1960s and 1970s consisted effectively only of developed and middle-income countries, and thus the middle-income countries had a comparative advantage in goods of low skill intensity. In the 1980s, when low-income Asia started to realize its own comparative advantage in goods of low skill intensity, the comparative advantage of middle-income countries shifted to goods of intermediate skill intensity. Rapid accumulation of skills in the East Asian economies that opened in the 1960s also helped to shift their comparative advantage toward goods of intermediate skill intensity.

The effect on relative wages in a middle-income country of opening to trade is thus likely to have changed over time. In the 1960s, increased openness would have raised the relative wage of unskilled workers, because it would have caused sectors of above-average skill intensity to shrink and sectors of below-average skill intensity to expand. In the 1980s, however, greater openness had conflicting effects on relative wages. Greater openness caused the contraction of sectors both of high skill intensity (replaced by imports from developed countries) and of low skill intensity (replaced by imports from low-income countries). The net effect might be in either direction, but greater openness could widen the wage gap between skilled and unskilled workers, as happened in the middle-income countries of Latin America in this period.

In theoretical terms, an increase in the effective relative world supply of unskilled labor lowers the relative world market price of unskilled-labor-intensive goods and thus alters the position of the open-economy demand curve. Figure 3 illustrates this process in the two-goods model introduced in figure 1: the lower relative world price of clothing is shown (with a dashed line) as a downward shift of the horizontal segment of DD.

Figure 4, the case of a many-goods model (as in figure 2), approximates the open-economy demand curve by a continuous downward-sloping line. The northwest quadrant depicts the world of the 1960s (with diagonal dd_1), consisting of developed countries (with unskilled to skilled labor ratios in the range $0A$) and

4. Data are from World Bank (1989: indicators table 17; 1995: indicators table 16, with Indonesia moved into the low-income group for consistency). The figure for the middle-income group is slightly inflated by the reclassification of countries in Eastern Europe and the former Soviet Union.

Figure 3. *Entry of Low-Income Asia: Two Traded Goods*

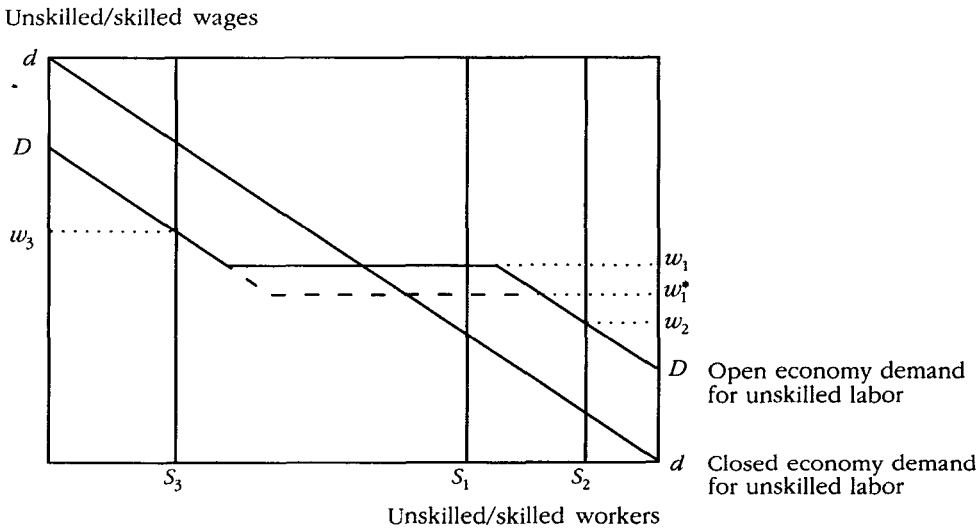


Figure 4. *Entry of Low-Income Asia: Many Traded Goods*

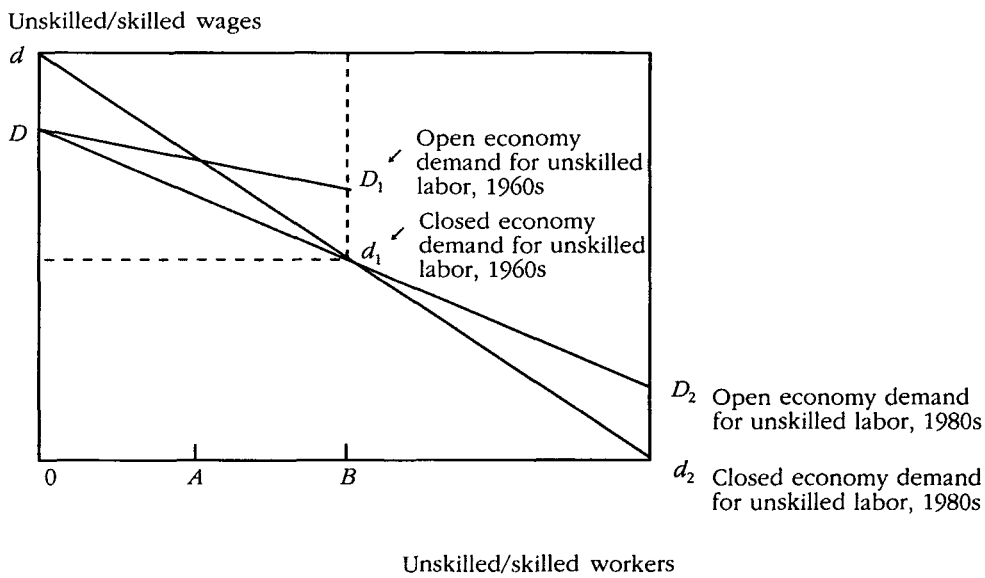


Figure 5. *Price of Developing-Country Manufactured Exports, Relative to Developed-Country Exports of Machinery, Transport Equipment, and Services, 1975–95*
(index: 1980 = 100)

Note: Manufactured export prices are unit value indexes from U.N. trade data. Service price index refers to the United Kingdom only and has a weight of 0.27 in the combined developed-country index.
Source: Update of Minford, Riley, and Nowell (1995: figure 6).

middle-income countries (in the range AB), but excluding the low-income Asian countries (with unskilled to skilled labor ratios beyond B). The open-economy demand curve in the 1960s is the line DD_1. The whole figure depicts the world of the 1980s. The closed-economy demand curve extends to d_2, and the open-economy demand curve pivots down to DD_2 (drawn for simplicity to cross dd_2 at B). For the middle-income countries, with skill supply ratios between A and B, DD_1 is above dd_1, but DD_2 is below it, so that opening to trade would have reduced wage inequality in the 1960s but increased it in the 1980s.

The coincidence in the late 1980s of expanding exports from low-income Asia with the opening to trade of Latin American countries provides a plausible explanation for the widening of wage differentials in the latter countries. This expansion of exports did apparently cause a downward shift in the open-economy demand curve from the mid-1980s to the mid-1990s, when, as shown in figure 5, the world price of unskilled-labor-intensive goods dropped relative to that of more skill-intensive goods.[5] There is also anecdotal and case study evidence that labor-intensive Latin American manufacturing sectors suffered as a result of

5. Patrick Minford kindly provided these data. For a discussion of earlier movements of a similar terms-of-trade index, see Sarkar and Singer (1991) and the October 1993 issue of *World Development*.

competition from Asian imports both domestically and in third markets such as the United States (for example, see Kaplinsky 1993).

A downward shift of the open-economy demand curve should also have affected relative wages in other countries that were already open to trade (through the Stolper-Samuelson linkage between product and factor prices), but only in those that produced both labor-intensive and other goods. Figure 3, in the simple two-goods case, thus shows that the downward shift of DD reduces (from w_1 to $w_1{}^*$) the relative wage of unskilled workers in the country with skill supply S_1, which produces clothing and machinery, but does not change relative wages in countries that specialize in one of the goods (S_2 in clothing, S_3 in machinery), since, with only one good produced, there can be no change in domestic relative producer prices. (However, the change in world prices does alter relative *consumer* prices and thus the *real* wages of all workers in the specialized countries, downward in S_2 and upward in S_3.) The distinction between diversified and specialized countries is blurred in figure 4, but however the diagrams are drawn, open *middle-income* economies—with intermediate unskilled to skilled labor ratios—are the ones most likely to produce both labor-intensive and more skill-intensive goods and so to have experienced external pressure for wider wage differentials.

Thus, an indirect test of the hypothesis that wage differentials widened in Latin American countries that opened to trade because of the simultaneous expansion of exports from low-income Asia would be to see whether wage differentials also widened during the same period in other, already open, middle-income countries. The time-series studies reviewed earlier reveal a mixed picture for such countries: in Hong Kong, wage differentials widened throughout the 1980s; in Taiwan and Singapore, they widened in the early 1980s but narrowed in the late 1980s; in Korea and Malaysia, they narrowed throughout the decade; and in Chile, they fluctuated (Robbins 1995b: figure 3; Wood 1994: 228–43). The estimated relative demand for skilled labor also moved in different directions in the three countries for which data are available—Chile, Malaysia, and Taiwan (Robbins 1995b: figure 6). The test is thus inconclusive on this small set of fairly open middle-income countries.

The hypothesis that the difference between the experience of East Asia in the 1960s and Latin America in the 1980s was caused by the entry of low-income Asian countries into world markets clearly requires further research. Such research should include a larger sample of open middle-income countries and should also examine the opening low-income countries themselves (whose wage differentials should have narrowed). Even more vitally, further research would need to look closely at the consistency of this hypothesis with the experience of the middle-income countries that have opened since the mid-1980s (again with a larger sample). In particular, it should use factor content analysis to check whether the reduction of trade barriers caused sectors of intermediate skill intensity to expand and sectors of low skill intensity to contract.

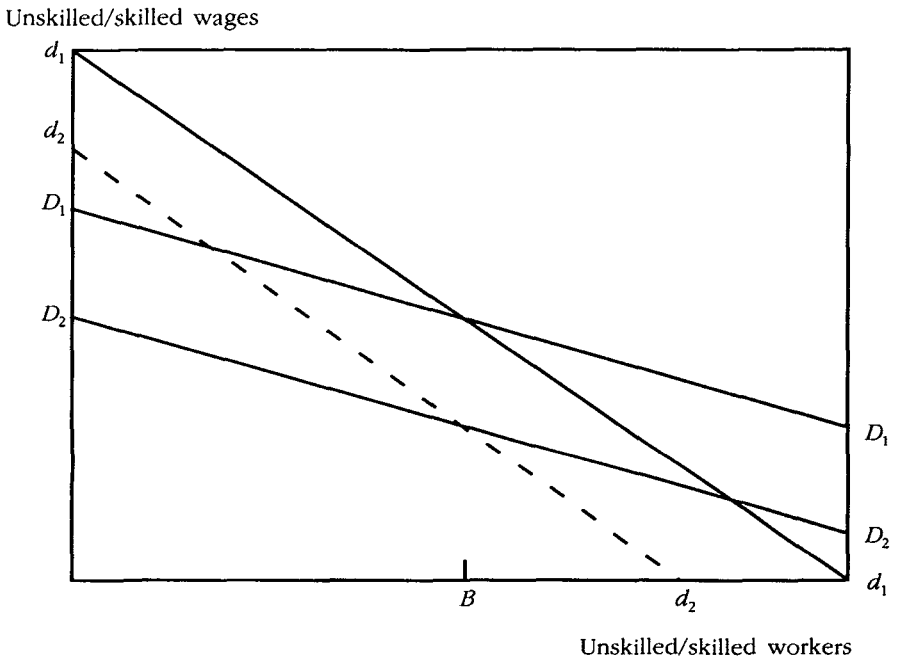
Skill-Biased Technical Progress

Another possible reason why opening to trade had different effects on wage inequality in the 1980s than in the 1960s is that world technology changed between these periods in a way that raised the relative demand for skilled labor. This explanation is put forward by Robbins (for example, 1995a), who calls it "skill-enhancing trade." He argues that increased openness in a developing country affects the skill structure of labor demand in two ways: by altering the sectoral composition of production (as in Heckscher-Ohlin theory) and by changing the production technology available—through increased imports of advanced capital goods, for example, or through opportunities for exporters to learn from foreign buyers and be exposed to foreign markets. The net impact depends on the size of these two effects and on the exact nature of the difference between domestic and world technology, but the effect on relative wages could be contrary to the predictions of standard Heckscher-Ohlin theory, which assumes that all countries always have access to the same technology. Moreover, the *real* wage of unskilled workers could rise, even if their *relative* wage falls, whereas under strict Heckscher-Ohlin assumptions, including constant returns to scale, real and relative wages should move in the same direction.

The skill-enhancing trade explanation is depicted in figure 6, in which there are two pairs of closed-economy and open-economy demand curves: d_1d_1 and D_1D_1 are based on the use of 1960s technology, d_2d_2 and D_2D_2 are based on the use of 1980s technology. In the figure, technology is assumed to have changed over time in a biased way, requiring a generally lower ratio of unskilled to skilled labor. Another assumption is that the new technology is available only to open economies, so that a country remaining closed to trade over this period would have continued to use 1960s technology. For most developing countries (to the right of B), opening to trade would thus have had different effects on wage inequality in the 1960s (decreasing it, by moving from d_1d_1 to D_1D_1) than in the 1980s (increasing it, by moving from d_1d_1 to D_2D_2). Even in the 1980s, the Heckscher-Ohlin tendency for openness to reduce inequality remains—reversion to a closed economy, with 1980s technology and demand curve d_2d_2, would aggravate the increase in wage inequality—but it is dominated by the effect of the change in technology.

The skill-enhancing trade explanation has considerable plausibility. It is likely that increased openness does alter the availability of technology. It is also widely believed that technical progress over the past couple of decades has in fact been biased against unskilled workers and that this is why wage inequality has increased in most *developed* countries. Moreover, Robbins (1996b) provides econometric support for this explanation: pooling the time series for six of the developing countries in his sample, he finds the relative demand for skilled labor to be positively correlated with the rate of growth of GDP and with the ratio of the imported capital stock to GDP, interpreting both variables as proxies for access to new technology.

Figure 6. *Effects of Openness and Technology Transfer*



Note: d_1d_1 and d_2d_2 are the closed economy demand curves for unskilled labor based on 1960s and 1980s technology, respectively. D_1D_1 and D_2D_2 are the open economy demand curves for unskilled labor based on 1960s and 1980s technology, respectively.

However, there is also considerable room for doubt about this explanation. The opening countries were not completely cut off from new technology. There is little hard evidence of an autonomous skill-using bias in recent technical progress, and there is another plausible explanation—increased openness to trade with developing countries—for the rise in inequality in developed countries (Wood 1995). And, as mentioned earlier, there is no consistent evidence of a rise in wage inequality, or in the relative demand for skilled labor, in open middle-income economies. In addition, Robbins's econometric results are open to alternative interpretations. Again, further research is needed, both to determine whether the open-economy demand curve has shifted down over time—an assumption common to the technological bias and the entry of low-income Asia hypotheses—and to establish which hypothesis provides a better explanation of this shift (including examination of movements in the *real* wages of unskilled workers, concerning which the two hypotheses make different predictions).

V. Summary and Conclusions

A substantial amount of empirical evidence supports the conventional wisdom that increased openness to trade in developing countries tends to raise the demand for unskilled, relative to skilled, labor and thus to reduce wage inequality. However, some recent evidence contradicts the conventional wisdom. In particular, there is a conflict in the time-series evidence between the experience of East Asia in the 1960s and 1970s, which is consistent with the conventional wisdom, and the experience of Latin America in the late 1980s and early 1990s, where increased openness appears to have widened rather than narrowed skill differentials in wages.

Possible explanations fall into two classes: differences between East Asia and Latin America and differences between the 1960s–70s and the 1980s–90s. Preliminary assessment of more specific explanations within these classes suggests that the reason is more likely to be the difference between the two time periods than the difference between the two regions. East Asia and Latin America differ in several respects, not least their endowment of natural resources, but it is difficult to establish a convincing causal link between any of these differences and the difference in the impact of increased openness on wage inequality.

By contrast, there are two plausible reasons why the effects of increased openness on wage inequality might have differed between the earlier and the later periods. First, the entry of China and other large low-income Asian countries into the world market for labor-intensive manufactures in the 1980s shifted the comparative advantage of middle-income countries into goods of medium skill intensity. As a result, increased openness in middle-income countries reduced the relative demand for unskilled workers by causing sectors of low skill intensity to contract. Second, technical progress between the 1960s and the 1980s was biased against unskilled workers.

The available evidence does not permit any strong conclusion as to which of these two period-difference explanations is the right one. More generally, the slender empirical basis of this whole exercise should be emphasized. The sample of developing countries for which there is recent evidence on trade and wage inequality is extremely limited—it not only is small but is also confined to East Asia and Latin America, covers no low-income countries, and covers no countries from Africa or South Asia. Within each country, too, there are gaps and other problems with the data and analysis. More research is needed to confirm whether the impact of increased openness on wage inequality has changed in recent years, as well as to determine how and why such change might have occurred.

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Technology and Firm Size-Wage Differentials in Colombia, Mexico, and Taiwan (China)

Hong Tan and Geeta Batra

In many economies, studies have found large wage differentials not accounted for by workforce characteristics, collective bargaining, or market power. Researchers attribute these differentials to either unobserved worker quality or pay incentives designed to elicit worker effort. This article finds empirical support for an alternative explanation: These wage differentials result from firms' technology-generating activities. Using firm-level data from Colombia, Mexico, and Taiwan (China), the article compares the effects of research and development, worker training, and exports by employers on the wages of skilled and unskilled workers. The results suggest that technology investments lead to large wage premiums for skilled workers but not for unskilled workers. These wage premiums are primarily the result of investments in research and development and in training, while exporting is relatively less important except in Colombia.

Technology plays a vital role in shaping the interfirm structure of wages in developing economies. How do the technology-generating activities of firms—broadly defined to include investments in research and development (R&D), foreign technology and know-how licenses, worker training, and exporting—affect the size structure of wages? Are the effects of these firm investments symmetrical with regard to all workers, or are they biased toward skilled workers as suggested by the skill-biased hypothesis of technical change? Which of these investment activities has the largest effects on wages?

Large differentials in wages paid to ostensibly similar workers characterize labor markets in many industrial and developing economies. For example, studies using household- or individual-level surveys have found sizable wage differentials, even after accounting for a wide range of human capital attributes such as age, sex, and education. These wage differentials appear to vary systematically by employer size and industry, to persist over long periods of time, and to be correlated across countries (Katz and Summers 1989). The enduring nature of these significant, and largely unexplained, wage differentials raises thorny questions about whether labor and product markets are efficient—especially in

Hong Tan and Geeta Batra are with the Private Sector Development Department at the World Bank.
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developing economies—and whether policy interventions to improve the operation of these markets are indicated.

Groshen (1991) advanced four hypotheses to explain these wage differentials, each with very different policy implications. Unexplained differentials may (a) reflect quasi-rents from imperfectly competitive markets; (b) compensate for differences in the quality of working conditions; (c) represent wage incentives designed to elicit greater worker effort and reduce shirking; and (d) reflect unmeasured worker quality and skills. To date most studies have found little empirical support for the first two hypotheses, as measured by the degree of unionization, market power of firms, or working conditions in jobs. The last two hypotheses are more difficult to test because of the paucity of relevant worker and firm-level data, and their efficacy in explaining these firm-size and industry wage differentials remains unclear.

A growing body of evidence, primarily from industrial economies, indicates that technological change influences wage inequality. Rising wage inequality in the United States between skilled and unskilled workers has been attributed to skill-biased technology by Katz and Murphy (1992), using time-series labor force surveys, and by Davis and Haltiwanger (1991), using panel firm data. Several recent U.S. studies using direct firm-level measures of technology use or R&D have found corroborating evidence for this hypothesis. Dunne and Schmitz (1995) find that use of advanced manufacturing technology is associated with significant wage differentials, with technology-wage premiums of equal magnitude as firm size-wage premiums. Bernard and Jensen (1994) jointly investigate the roles of exporting and R&D by employers and find evidence that both activities are associated with wage differentials. Similar research on these hypotheses in developing economies is limited; however, using firm-level data from the 1986 Taiwan (China) census, Aw and Batra (1995) find that the average wage premiums associated with exporting were 24 percent.

Research has focused on the linkages between technology and worker training and their consequences for wage growth and wage inequality. Using worker-level data with self-reported training measures, several studies find evidence in industrial economies that the propensity to train is greater for more educated workers, larger firms, and employers in R&D-intensive industries. Furthermore, these studies show higher returns to training in technologically progressive industries (Mincer 1991; Lillard and Tan 1992; Tan and others 1992). Several firm-level studies, exploiting linkages with employee files, have found similar correlations between technology use by employers and wages and worker characteristics (Doms, Dunne, and Troske 1994; Hellerstein, Neumark, and Troske 1994). Because the firm-level studies had no data on worker training, the possibility remains that part of the technology-wage premiums that they estimated—for different firm-worker characteristics—may actually reflect important, but largely unmeasured, employers' investments in worker training and skill upgrading.

In this article, we bring together unique firm-level data from three developing economies—Colombia, Mexico, and Taiwan (China)—to investigate the rela-

tionships between technology and the interfirm structure of wages in manufacturing. The data for Taiwan (China) are for 1986, and those for Mexico and Colombia are for 1992. Each firm reported information on several key groups of variables: mean wages by level of worker skill, firm and industry characteristics, and the firm's technology inputs. We hypothesize that firms acquire technological knowledge through three channels: exports, an informal channel to technology and know-how from abroad; investments in new technology, either through foreign licenses or through own R&D efforts; and worker training, which is a critical input in the adoption, modification, and effective use of new technologies.

For each economy, we estimate semiparametric models to characterize the size-wage distributions of two groups of firms differentiated by their technology orientation: firms that invest in one or more of the three channels of technology (investors) and firms that do not invest in any of the three (noninvestors). We compare the firm size-wage distributions of skilled and unskilled workers in investor firms and noninvestor firms to test the hypothesis of skill-biased technical change. It is possible that some sources of technology have a larger impact on wages than others. To identify the relative wage impacts of each of these technology investments, we also estimate separate models for each technology source while controlling for investments in the other two technology sources.

Section I discusses the motivation for the analysis, drawing upon salient findings from our parallel research on training and its effects on firm-level productivity and wages using data from these developing economies. Section II describes the data, provides some descriptive statistics on the firms in our samples, and discusses the econometric model to be estimated. Section III reports the principal findings. Section IV summarizes the cross-economy results and draws out their policy implications.

I. Technology and Wage Differentials

Our analytic approach is motivated by a model in which firms develop technological capabilities through conscious investments in knowledge-generating activities. Firms can develop these capabilities—including own R&D and purchases of foreign technology and know-how, worker training and skill upgrading, as well as exports—in different ways, and each investment strategy may have different productivity and wage outcomes. We focus on estimating the wage outcomes of these technology-generating activities, both jointly and separately by source, and on how these activities shape the size-wage distributions in Colombia, Mexico, and Taiwan (China).

Our definition of technological capability follows Bell and Pavitt (1993). They distinguish between production capacity and technological capability. Production capacity measures the capacity of firms to produce output at given levels of efficiency with existing inputs of capital, labor, and technology. Technological

capability incorporates the additional and distinct resources needed to generate and manage technological change, including specialized managerial and technical skills, knowledge and experience, and linkages with other firms. Employers whose workers have these specific skills and knowledge have a productivity advantage over less capable firms. The firm-specificity of these skills and knowledge creates a bilateral monopoly situation and incentive problems of motivating workers to acquire and exercise specific skills. The bilateral monopoly problem is resolved through firm-worker sharing of the higher productivity (rents) from these technology investments (Becker 1975; Tan and others 1992; Lindbeck and Snower 1989).

We assume that there is a prior distribution of technological capabilities in a given economy at any point in time. The heterogeneity in capabilities and its correlation with firm size have been modeled by Lucas (1978), Jovanovic (1982), and Dunne and Schmitz (1995), among others, in the context of advanced technology use. The Dunne and Schmitz study finds evidence that larger firms are more likely to use advanced technology, that technology usage is related to significant wage differences, and that technology-wage premiums are roughly of the same magnitude as size-wage premiums. In addition, employer incentives to invest in new technology may vary across industries because of interindustry differences in technological possibilities. In science-based industries, such as chemicals and electronics, the potential for product and process innovations is typically greater than in traditional industries such as leather and furniture. These technology differentials can give rise to a distribution of wages across employers, varying the distribution by size and industry—differentials that can persist because of the firm-specificity of technology investments. If technology is the driving force, then similar interindustry differentials are likely to be found across countries.

Tabulations of the data for Colombia, Mexico, and Taiwan (China) indicate that larger firms are typically more likely to train their workers, license foreign know-how, or invest in R&D, while smaller firms tend not to train and to rely on older and less skill-intensive kinds of technology. The data also show systematic differences across industries in the proportion of firms that invest in R&D and training, with the propensity to train workers, conduct R&D, or purchase know-how being higher in the science-intensive industries than in the more traditional, labor-intensive industries.

Technological capabilities can be developed in several ways. First, employers can invest in their own R&D or purchase technology and know-how through licensing agreements with foreign firms. The evidence from developing countries suggests that reverse engineering, imitation, and modification of foreign technology have been more critical to developing capabilities than own investments in basic research and innovation (Pack 1992b). Second, firms can acquire relevant and best-practice technology through their links with foreign buyers of exported products as well as with foreign firms operating in the local markets (Westphal, Rhee, and Pursell 1984; Pack 1992a). Finally, whether it is through

importing foreign technology or using, adapting, and redesigning technology through deliberate investments in R&D, building technological capacity depends fundamentally on the education and training of the workforce. As technologies evolve, a continuous process of job-specific training and retraining is needed to supply the technical and managerial skills required by new process and product innovations.

There is a body of evidence from both industrial and developing countries that technologically progressive industries are more likely to train their workers and that these investments give rise to higher wages (Lillard and Tan 1992; Tan and others 1992). Using census data from Taiwan (China), Aw and Tan (1993) show that worker training has a large positive impact on firm-level productivity in all industries studied and that this effect is larger when training is accompanied by complementary investments in formal R&D and foreign know-how.

Our related research on the productivity effects of enterprise training supports the focus here on elements that are important in developing technological capabilities (see Tan and Batra 1995). First, within a production function framework, our cross-national analyses showed significant firm-level productivity gains from investments in each of the three sources of technology. Our findings of positive productivity effects from R&D and exporting are consistent with those reported in the productivity literature (see Bregman, Fuss, and Regev 1991). The productivity effects of training, however, are new. The results showed that formal training of skilled workers had a significant, positive effect on firm-level productivity, while the productivity effects of unskilled worker training were generally insignificant.

Second, we found that some of the productivity gains from training were shared with workers in the form of higher wages. The results of joint estimation of a production function and wage model showed that the training effects in the wage model were approximately two-thirds those of training in the production function. The implied sharing of productivity gains—one-third to the employer, two-thirds to workers—was of roughly the same magnitude across the three economies. Firm-worker sharing of the costs and returns to training are consistent with the presence of firm-specific training (Becker 1975).

These two findings—the link between investments in technology and firm-level productivity, on the one hand, and the link between productivity and wages, on the other—constitute the empirical basis for this article. We build on these findings to investigate the firm size-wage distribution across different groups of firms varying in technological orientation, by skill level, and across economies.

II. Data and Methodology

The data required to investigate the hypothesized technology-wage relationships are available for a cross-section of firms in the three economies—Colom-

bia, with 500 firms for 1992; Mexico, with 5,072 firms for 1992; and Taiwan (China), with 8,408 firms for 1986.[1] The three surveys of manufacturing firms contain broadly comparable, firm-level information on the key variables of interest. These include characteristics of the establishment, including year established, single-plant or multiplant status, two-digit industry classification, and foreign ownership; data on production and inputs, including capital assets, employment, intermediate inputs, and energy use; number of workers and mean wages by broad occupations; and information on exports, training, and expenditures on R&D and foreign technology licenses.

Variable Definitions

"Training" is defined to include only formal structured training provided by the employer, whether by in-house trainers or by external providers, but excludes informal on-the-job training provided either by coworkers or by supervisors. A more inclusive training variable would have little discriminatory power because most employers provide some informal on-the-job training, especially to new hires. The decision to exclude informal on-the-job training was informed by the findings of existing training studies (for example, see Lillard and Tan 1992) and by our own analyses of the productivity effects of different types of formal and informal training (see Tan and Batra 1995). The training variable is based on the number of employees trained by each source, except in Taiwan (China) where it is defined by positive expenditures on (presumably formal) training. Training in the Taiwan (China) sample, in all likelihood, is understated by our reliance on reported training expenditures, which are often not adequately recorded, rather than on the number of workers trained where better data are available. Thus more training firms in Taiwan (China) are probably misclassified as nontrainers than in the other two countries. For the Taiwan (China) analysis, this is likely to cause a downward bias in the estimated effects of training on wages, which strengthens our test for the presence of training-wage premiums.

The variable "investment in R&D and know-how" is defined as positive expenditures on either research and development or on the purchase of foreign technology and know-how licenses. We note that R&D is defined more broadly in Mexico and Colombia than in Taiwan (China) and includes less-formal, adaptive R&D and engineering modifications to product and process technologies. The variable "exports" is defined simply as having positive foreign exports.

We will refer to these three variables as sources of technology and use them to separate firms into two groups, investors and noninvestors. Investors invest in

1. We exclude *maquiladora* firms from the Mexico sample because of the their unique, assembly-for-export characteristics. These firms, although typically large, conduct virtually no R&D and generally pay lower wages to both skilled and unskilled labor. Although they were not explicitly identified in our sample, we defined *maquiladora* firms as those that export 67 percent or more of their total output and import 75 percent or more of their raw materials. Thus, we dropped 305 firms from the analysis. We acknowledge Amy Hwang (Academia Sinica) for providing the data for Taiwan (China); the Secretariat of Labor (Mexico) for providing the data for Mexico; and SENA, the National Training Agency, for the data for Colombia.

any one, or more, of the three sources of technology. Noninvestors do not invest in any of them. We chose this simple stratification to facilitate comparisons between investors and noninvestors and between the three technology sources and to ensure that the sample size for different groups was adequate for analysis. In the simple stratification, a firm is defined as an investor by one of seven combinations of investments in any one or more of the three dichotomous technology indicators. The number of investor permutations rises quickly when each indicator variable is stratified by intensity, making the analysis intractable because of small sample sizes in each investor category. However, we do report some findings for a more disaggregated stratification of firms by intensity of their technology investments.

For each economy, we construct comparable definitions of skilled and unskilled workers using information on the broad occupational breakdowns of the workforce in the firm. For Taiwan (China), the group of *skilled workers* includes managers, engineers, and technicians; for Mexico, it includes directors, professionals, engineers, supervisors, and technicians; for Colombia, it includes administrators, technicians, and supervisors. *Unskilled workers* in all three economies comprise unskilled production workers and employees in the residual "other administrative" group. This breakdown of skills is an improvement over the more commonly used breakdown between production and nonproduction workers. For Colombia and Mexico, but not Taiwan (China), we also have information on the educational distribution of workers in the firm. We have not used these data here in the interest of cross-national comparability, but education is partly reflected in our refined measures of skills.

Our wage variable is defined as *monthly wages and salaries*. It excludes fringe benefits and other nonwage payments because these data, while reported, are for the workforce as a whole and are not broken down by occupational group. In Taiwan (China), nonwage payments for the investor sample are on average 40 percent higher than those for noninvestors. In Mexico, the different bonuses for which we have data—for example, productivity, quality, and punctuality bonuses—are also on average higher among technology investors than among noninvestors and rise with firm size. Thus, inclusion of fringe benefits, bonuses, and other nonwage payments should result in higher technology-wage premiums in these economies and reinforce our findings.

Overview of the Data

In all three surveys, large firms were oversampled relative to their true weight in the population of industrial enterprises. The population of smaller firms, microenterprises in particular, is not known with any precision in Colombia and Mexico. A further complication is that the Taiwan (China) sample was selected on the basis of sales. Although crude population weights exist for Colombia and Mexico, we have opted to report only unweighted figures until more comparable weights can be developed for all three countries.

Table 1. *Mean Characteristics of Sample Firms in Colombia, Mexico, and Taiwan (China), by Technology Source*

			Percentage of firms		
Economy	*Number of firms*	*Number of employees*	*Formal training*[a]	*R&D licenses*	*Exporting*
Colombia	500	186.00	65.60	76.60	40.00
Mexico	5,072	297.81	56.77	50.43	18.23
Taiwan (China)	8,408	145.47	15.84	25.89	51.42

a. For Colombia and Mexico, it includes firms that report formal internal or external training. For Taiwan (China), it includes firms that report training expenditures.
Source: Authors' calculations.

Table 1 indicates that the average firm size is about 298 employees in Mexico, 186 employees in Colombia, and 145 employees in Taiwan (China). Given the over-representation of large firms, these statistics cannot (and should not) be used to draw inferences about the relative level of technology orientation in the three economies. With this caveat, the remaining columns of table 1 show the percentage of firms in each economy reporting formal training, investments in R&D and technology licenses, and exports.

Table 2 shows the mean characteristics of firms by their technology orientation. In all three economies, in comparison with noninvestors, firms that invest in any of the sources of technology tend to be larger (in terms of employment) and older (they have been in operation longer), have multiple plants and a higher proportion of foreign capital, and pay higher wages to both their skilled and unskilled employees. Given the stylized finding of a firm size-wage relationship in most economies, part of the higher wages paid by investors in technology (or any source of technology) reflects their larger average size. In the analysis that follows, this firm size-wage relationship is explicitly modeled in estimating the technology-wage premium; interindustry differences are accommodated by a vector of two-digit industry dummy variables, but these are not the focus here.

Empirical Methodology

The impact of technology on industrial wage differentials is investigated in several ways. First, we compare the wage distributions of the two groups of firms that differ in their technology orientation and test the hypothesis that, other things being equal, technology investors pay higher wages. Employer size is a useful way to characterize this distribution of wages because technological capability is thought to be a positive function of firm size. Second, the wage comparisons are done separately for skilled and unskilled workers. If technological change is highly skill-demanding, as suggested by the literature, then employer investments in technology should have a larger wage impact on skilled workers relative to unskilled workers. Finally, we estimate the separate wage effects of employer investments in exporting, worker training, and R&D to see which technology strategy has the largest impact on wages and whether there are major differences across economies in the role of each technology source.

Table 2. *Mean Characteristics of Sample Firms in Colombia, Mexico, and Taiwan (China), by Technology Orientation*

Economy and technology orientation	*Number of employees*	*Years in operation*	*Multiple plants (percentage of firms)*	*Foreign ownership (percentage of firms)*	*Percentage of skilled labor*	*Ratio of wages paid by investors to those paid by noninvestors*		*Ratio of wages paid to skilled workers to those paid to unskilled workers*
						Skilled labor	*Unskilled labor*	
Colombia								
Investors	203	20.82	20.31	—	0.23	2.36	2.69	2.50
Noninvestors	43	14.52	3.85	—	0.24	n.a.	n.a.	2.13
Mexico								
Investors	349	23.99	22.74	18.97	0.31	1.30	1.26	3.79
Noninvestors	130	18.74	11.72	6.67	0.29	n.a.	n.a.	3.47
Taiwan (China)								
Investors	227	12.68	33.69	11.03	0.49	1.34	1.21	1.81
Noninvestors	31	10.76	13.06	1.52	0.55	n.a.	n.a.	1.86

— Not available.
n.a. Not applicable.
Note: Investors are defined as firms reporting investments in R&D or formal training (internal or external) or export.
Source: Authors' calculations.

These wage comparisons are based on nonparametric and semiparametric regression methods (Robinson 1988; Hardle 1990). In initial data exploration, we found the firm-level wage data to have a lot of noise and the size-wage distributions to be nonlinear. In preliminary analyses, we compared wage models estimated by ordinary least squares (OLS) and nonparametric methods in each of the three economies and concluded that the size distribution of wages was better estimated by nonlinear methods. Although the OLS parameter estimates are broadly comparable to the nonparametric estimates for wage intercept differences between investors and noninvestors, and for other explanatory variables such as industry and firm characteristics, they differ markedly in estimates of the size-wage distribution. The OLS quadratic size specification yields poor results because of its sensitivity to noise, nonlinearities, and outliers.

Thus we adopted a more flexible approach. Unlike the more familiar linear regression technique, the wage models we estimate impose no specific functional form on the data, such as a quadratic firm-size specification, in effect allowing the data to speak for themselves. Deaton (1989) discusses these and other advantages of nonparametric techniques over alternative, more familiar econometric techniques such as cross-tabulations, which are not very flexible and do not convey information as transparently, and linear regressions, which tend to oversummarize and rarely do justice to the amount of information available. The semiparametric model extends this methodology by combining a parametric component with the nonparametric one. We let the nonparametric component be related to firm size and the parametric component be a function of other firm attributes, such as age of the firm, multiplant status, foreign capital ownership, and industry. The semiparametric approach thus enables us to compare the within-industry, firm size-wage distributions of technology investors and noninvestors net of the wage effects of other firm-specific factors and cross-industry wage-level differentials.

The semiparametric wage model has the following form:

$$y = x'\beta + \theta(z) + u \tag{1}$$

where y represents the dependent variable, log(wage), β is assumed to be a linear function of x, a matrix of firm attributes including foreign ownership, firm age, multiplant status, and industry. The nonparametric component, firm size, is represented by z, measured as log (employment), and u, the error term, is assumed to be independently and identically distributed with finite variance.

The estimation is done in two stages. In the first stage, we obtain the coefficients of x, that is, β, using a kernel nonparametric method and a smoothing parameter designed to minimize the sum of squared residuals (described in greater detail in the appendix). In the second stage, to obtain the relationship between wages and firm size net of the wage effects of other firm and industry characteristics, we estimate the following nonparametric model

$$y - x'\beta = \theta(z) \tag{2}$$

where, as before, y is log (wage), $x'\beta$ is a vector of predicted values obtained from the first-stage estimation, z is firm size as measured by log (employment), and θ is the function relating wages to firm size.

We estimate a semiparametric wage model for each group of firms, the technology investors and noninvestors samples, and, within each firm sample, separate regressions for skilled workers and for unskilled workers. Because we have already controlled for the wage effects of $x'\beta$, differentials in the size distribution of wages between the two groups of firms are attributed to employer investments in exports, training, or R&D and know-how. Wage differentials for the two skill groups can also be compared to test the hypothesis of skill-biased technological change.

We extend this semiparametric methodology to estimate the separate wage effects of each technology source. Recall that firms are classified as being in the investor sample if they do one or more of the following: exports, training, or R&D and know-how. For any given technology source, we estimate the semiparametric wage model for that group of investors, controlling for the wage effects of contemporaneous investments in the other two technology sources. For example, to estimate the wage effects of training, we expand $x'\beta$ to include two dummy variables—for exporting and for R&D and know-how—so that $\theta(z)$ provides an estimate of the pure size-wage effects from training. (This procedure ignores second-order, and possibly important, interaction effects between training and the other two technology sources.)

III. Empirical Findings

The first set of regressions compares the wages paid by technology investors and by noninvestor firms. We first report the parametric component of wages—firm characteristics and industry effects. We then present graphical comparisons of the nonparametric wage component, the firm size-wage distributions by skill group, for the investor and noninvestor samples. The second set of regressions disaggregates these results by technology source—exports, worker training, and investments in R&D and know-how. For brevity, the discussion here focuses only on the size-wage distributions net of the parametric wage component.[2]

Technology Investors and Noninvestors

Table 3 reports the semiparametric coefficient estimates for the wage effects of different firm-level characteristics, separately by the technology orientation of firms and by skilled and unskilled worker groups. These estimates hold constant interindustry wage-level differentials; these are discussed subsequently.

Table 3 highlights what appear to be common correlates of firm-level productivity across all three economies. First, firm age is generally associated with a

2. The parametric estimates by source of technology resemble those found for the aggregate measure of technology orientation. The detailed results are available from the authors.

Table 3. *Estimates of the Impact of Firm Characteristics on Wages in Colombia, Mexico, and Taiwan (China)*

	Skilled labor			*Unskilled labor*		
Economy and technology orientation	*Years in operation*	*Multiple plants*	*Foreign ownership*	*Years in operation*	*Multiple plants*	*Foreign ownership*
Colombia						
Investors	0.002	0.103*	—	0.002*	0.052	—
	(0.002)	(0.060)		(0.001)	(0.043)	
Noninvestors	0.003	0.188	—	0.001	0.265**	—
	(0.004)	(0.225)		(0.002)	(0.116)	
Mexico						
Investors	0.067***	0.189***	−0.037	0.004***	0.102***	0.175***
	(0.030)	(0.034)	(0.100)	(0.001)	(0.027)	(0.029)
Noninvestors	0.003*	0.096	0.227**	0.003*	0.096	0.131
	(0.002)	(0.085)	(0.112)	(0.002)	(0.071)	(0.093)
Taiwan (China)						
Investors	0.006***	0.022	0.227***	0.006***	0.024	0.093***
	(0.001)	(0.013)	(0.020)	(0.001)	(0.017)	(0.026)
Noninvestors	0.007***	0.094***	0.379***	0.005***	0.011	—
	(0.001)	(0.026)	(0.068)	(0.002)	(0.035)	

— Not available.

Note: Values are semiparametric coefficient estimates. The dependent variable is the log of the wage of labor. Numbers in parentheses are standard errors.

* Significant at 10 percent.

** Significant at 5 percent.

*** Significant at 1 percent.

Source: Authors' calculations.

positive and statistically significant effect on wages, except in Colombia. This finding is consistent with the interpretation that longevity is correlated with firm-level productivity, because less efficient firms have a greater likelihood of exit (Jovanovic 1982). Second, foreign ownership is associated with significantly higher wages in Mexico and Taiwan (China) (this variable was not collected for Colombia), possibly because of their higher technological capabilities. (See Tan and Batra 1995 for cross-country findings on the productivity differentials associated with foreign ownership of firms.) Finally, multiplant status is associated with higher wages, but its statistical significance is mixed. Several U.S. establishment-level studies find large multiplant wage effects; the mixed results reported here may simply reflect the fact that our unit of observation is the firm, not the establishment, and that firm-size effects (for which multiplant status is a proxy) are captured in the nonparametric wage component.

Industry dummy variables were also included in the semiparametric wage models to control for interindustry wage differentials. Though not reported here, industry intercepts estimated in each regression suggest that two findings are common to all three economies. First, there appear to be two distinct groups of industries: industries that pay high wages (typically chemicals, pharmaceuticals, general and electrical machinery, basic metals, and transportation equipment) and industries that pay low wages (usually food and beverages, clothing and

textiles, leather, and wood and furniture products). Second, the magnitude and statistical significance of interindustry wage differentials are usually greater for the sample of technology investors, especially in the skilled-worker regressions. In contrast, interindustry wage levels are relatively undifferentiated in the case of unskilled workers.

The similarities of these two findings across economies are consistent with the hypotheses of interindustry differences in technological possibilities and their associated differential demand for skilled workers. The findings raise questions about the efficacy of more traditional explanations that relate industry wage differentials to market structure, openness to trade, and unionization. We did not explicitly address these competing explanations, given the limited two-digit industry variation in our data, but we argue that cross-national variations in these factors could not give rise to the common patterns of interindustry wage differentials observed.

The Size Distribution of Wages

Our estimates of the nonparametric wage components show the size-wage distributions net of the parametric wage effects reported above. At any given firm size, the gap between the two curves for technology investors and noninvestors is a measure of the percentage wage differential between the two groups of firms. Because investors and noninvestors differ only in whether they invest in any technology, this wage gap is an estimate of the technology-wage premium.

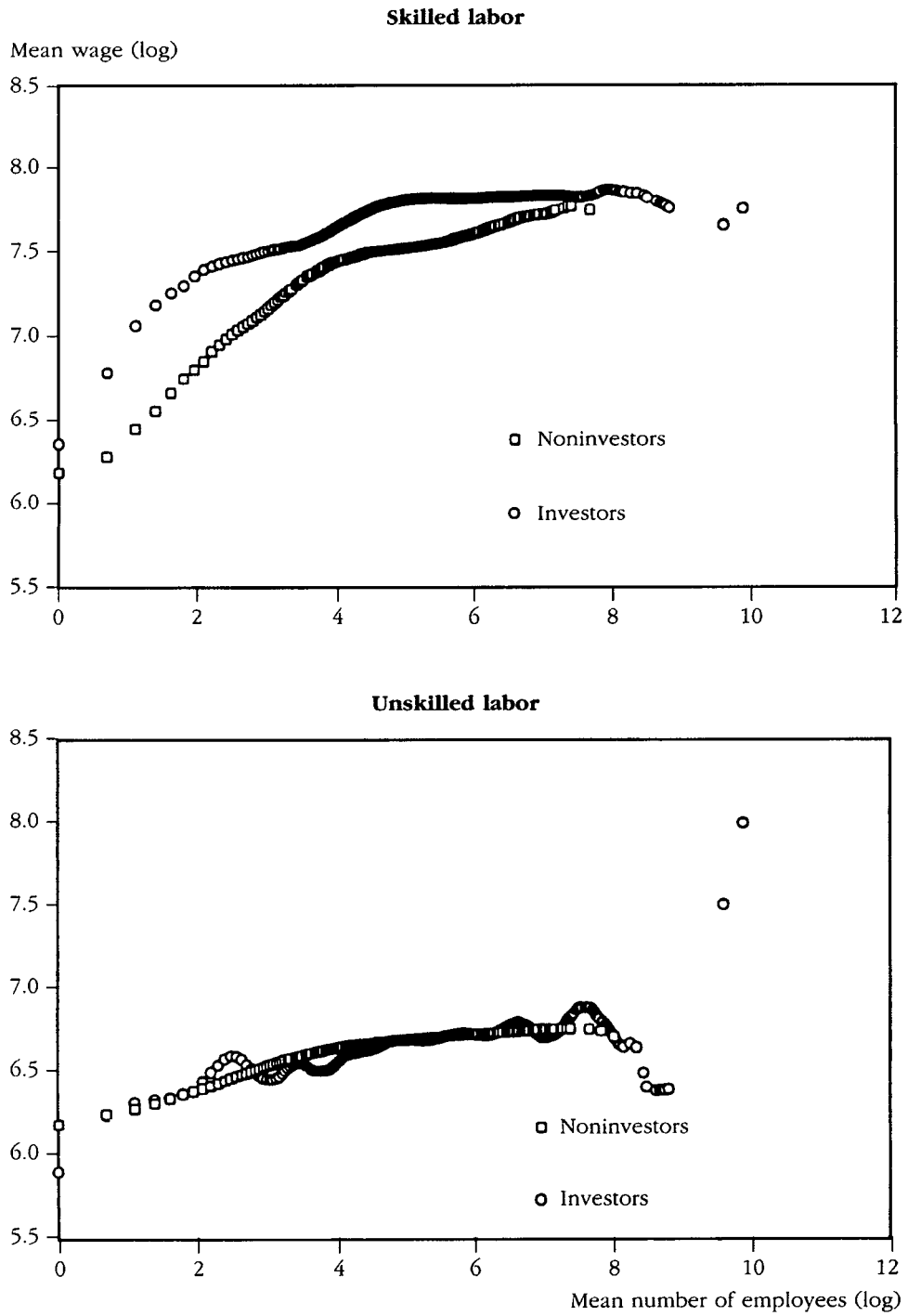
To facilitate comparisons by firm size, we adopt the following firm-size nomenclature for all economies. We define firms with less than 16 employees as micro, firms with 16 to 100 employees as small, firms with 101 to 250 employees as medium, and firms with more than 250 employees as large. We use these definitions to report average wage premiums by discrete firm-size categories.

Figure 1 presents our estimates of the size-wage distributions for Mexico. The wages paid to skilled workers are everywhere higher in firms that invest in technology than in those that do not; furthermore, the wage differential is largest for technology investors in the smaller firm-size range. Compared with the wage premiums paid by noninvestors, those paid by micro, small, medium, and large firms that invest in technology are 88, 33, 32, and 21 percent, respectively.

The corresponding size-wage distributions for unskilled workers are not well differentiated by the technology orientation of firms. For the smallest and biggest firms, wages paid to unskilled workers by technology investors are slightly higher than those paid by noninvestors. The reverse is true for medium-size and larger firms—investors pay slightly lower wages to unskilled workers as compared with noninvestors. By discrete size categories, the technology-wage premiums paid by investors relative to noninvestors are 13, –4, –1, and 1 percent for micro, small, medium, and large firms, respectively.

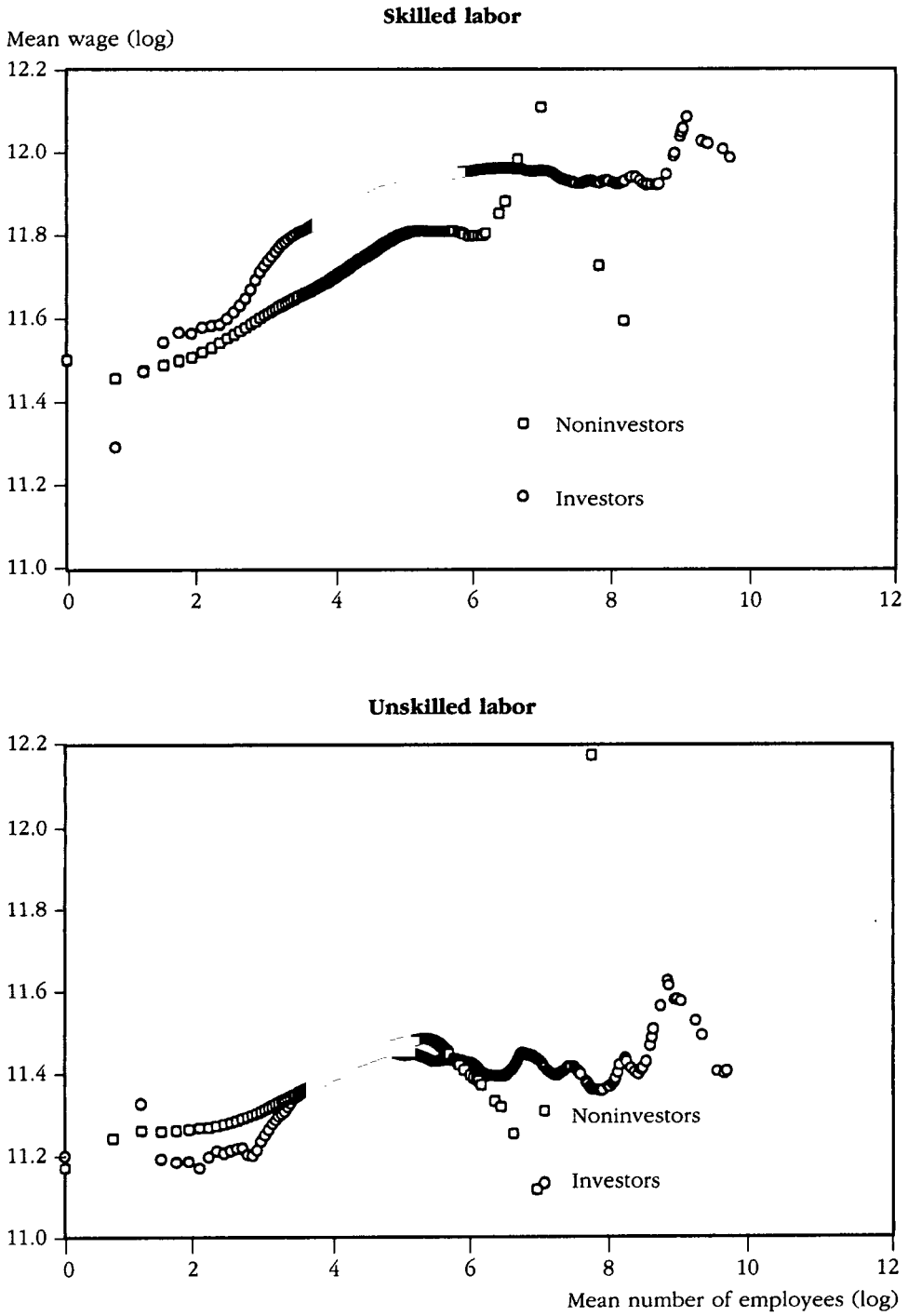
Figures 2 and 3 show the corresponding size-wage distributions for Taiwan (China) and Colombia, respectively. For skilled workers, the size-wage

Figure 1. *Estimates of the Size-Wage Distributions for Skilled and Unskilled Labor, Mexico*



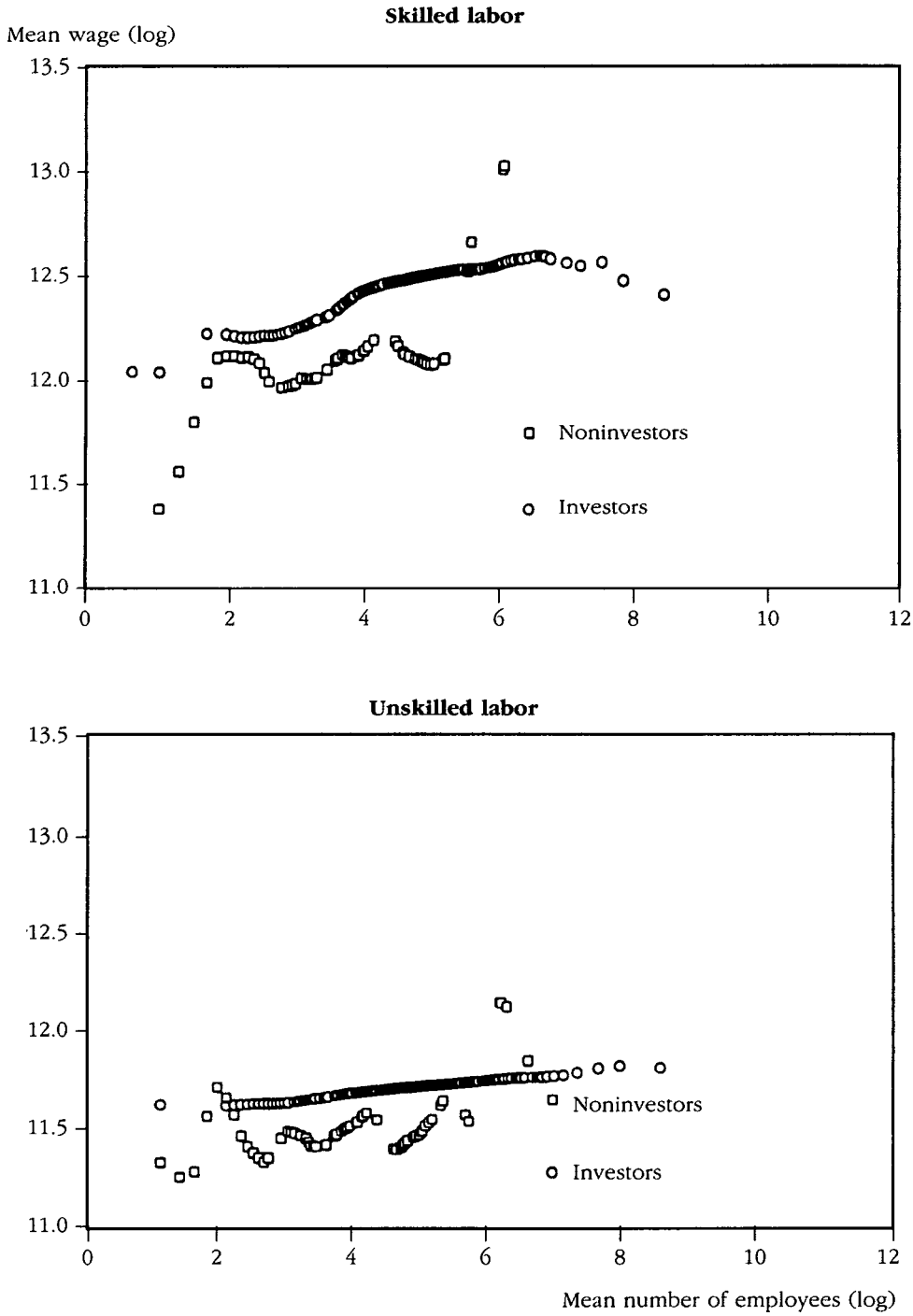
Source· Authors' calculations

Figure 2. *Estimates of the Size-Wage Distributions for Skilled and Unskilled Labor, Taiwan (China)*



Source: Authors' calculations.

Figure 3. *Estimates of the Size-Wage Distributions for Skilled and Unskilled Labor, Colombia*



Source. Authors' calculations.

distributions in Taiwan (China) and Colombia resemble those in Mexico in being higher for technology investors than for noninvestors. However, each of these economies has slightly different patterns of technology-wage premiums by firm size. For Taiwan (China) (figure 2), the technology premium for skilled workers is highest in the small size category, and the premiums decline with firm size as in Mexico. The technology-wage premiums for skilled workers in Taiwan (China) are 8, 21, 15, and 14 percent in micro, small, medium, and large firms, respectively. For Colombia (figure 3), by contrast, the technology-wage premiums for skilled workers tend to rise with size (except for the largest firms); the corresponding wage premiums by size are 20, 34, 48, and –22 percent, respectively.

For unskilled workers, technology investors in Taiwan (China) and Colombia—as their Mexican counterparts—pay smaller wage premiums for unskilled workers than for skilled workers. In Taiwan (China), there is no systematic pattern by firm size—the mean wage premiums by size are –7, 3, –3, and 0 percent for micro, small, medium, and large firms, respectively. In Colombia the firm-size pattern of technology premiums for unskilled workers resembles that for skilled workers. The corresponding premiums by size are 19, 22, 26, and –13 percent for micro, small, medium, and large firms, respectively.

Technology-wage premiums are averages across all investor firms, irrespective of the intensity of their investments. To verify that the wage effects of technology increase in proportion to investment intensity, we estimated pooled OLS wage models with indicator variables for two intensity levels—moderate and high—measured relative to noninvestors. This OLS wage model has the same variable specification as the nonparametric model except for the inclusion of a quadratic firm-size measure and indicator variables for moderate and high-intensity investors. (This wage model was estimated for Mexico and Taiwan (China), but not Colombia, where small sample size precluded this disaggregation.) A firm is defined to be a high-intensity investor if it invests more than the median intensity in any one of the three technology sources; otherwise it is a moderate investor. The OLS estimates suggest that high-intensity investors pay significantly higher wages than moderate-intensity investors, and both investor groups pay higher wages compared with noninvestors. The results also suggest that technology-wage differentials are larger among skilled workers than unskilled workers. Both results are consistent with our nonparametric findings and reinforce our interpretation of these wage differentials.

To summarize, the results for all three economies provide evidence of large technology-wage premiums for skilled workers, and small or nonexistent technology-wage premiums for unskilled workers (table 4). (We tested, and rejected, the null hypothesis that the wages of skilled workers are the same in investor and noninvestor firms across all size categories.) In Mexico the overall (pooling across firm sizes) technology-wage premium for skilled workers is 54 percent, which is substantial, but the premium for unskilled workers is just 11 percent. In Taiwan (China) the corresponding overall premiums for skilled and unskilled

Table 4. *The Technology-Wage Premium by Labor Type in Colombia, Mexico, and Taiwan (China)*
(percent)

	Skilled labor				*Unskilled labor*			
Economy	*Training*	*R&D*	*Exports*	*Any investment*	*Training*	*R&D*	*Exports*	*Any investment*
Colombia	39.93	24.23	61.12	41.76	20.20	8.65	29.18	22.51
Mexico	76.12	74.54	51.29	53.88	17.82	12.75	−2.37	10.96
Taiwan (China)	53.88	51.13	22.38	31.92	14.91	16.77	1.92	7.47

Note: Values are based on semiparametric regression results. Technology premium is defined as the overall difference between the average wage of firms investing in any source of technology and the average wage paid by noninvestors. The wage premiums for each technology source (training, R&D, exports) are estimated controlling for investments in the other sources of technology.

Source: Authors' calculations.

workers are 32 and 7 percent, respectively; in Colombia the skilled and unskilled technology-wage premiums are 42 and 23 percent, respectively.

We interpret these results as evidence of skill-biased technological change. We note that the same findings are also consistent with skill-neutrality if two assumptions hold: that technology raises the productivity of skilled and unskilled workers to the same degree and that skilled workers are not mobile across firms (so wage premiums can persist), while unskilled workers are mobile and readily substitutable for each other (thus competing away wage differentials).[3] However, we discount this competing explanation on the basis of two findings from our related research (Tan and Batra 1995). First, there is strong cross-national evidence that training for skilled workers has a large productivity impact, but training for unskilled workers does not. Second, although skilled workers are generally less mobile than unskilled workers, the evidence suggests that technically efficient firms, which are highly correlated with our investor firms, have lower job turnover rates among employees than inefficient firms, which make few technology investments.

Size-Wage Distributions by Technology Source

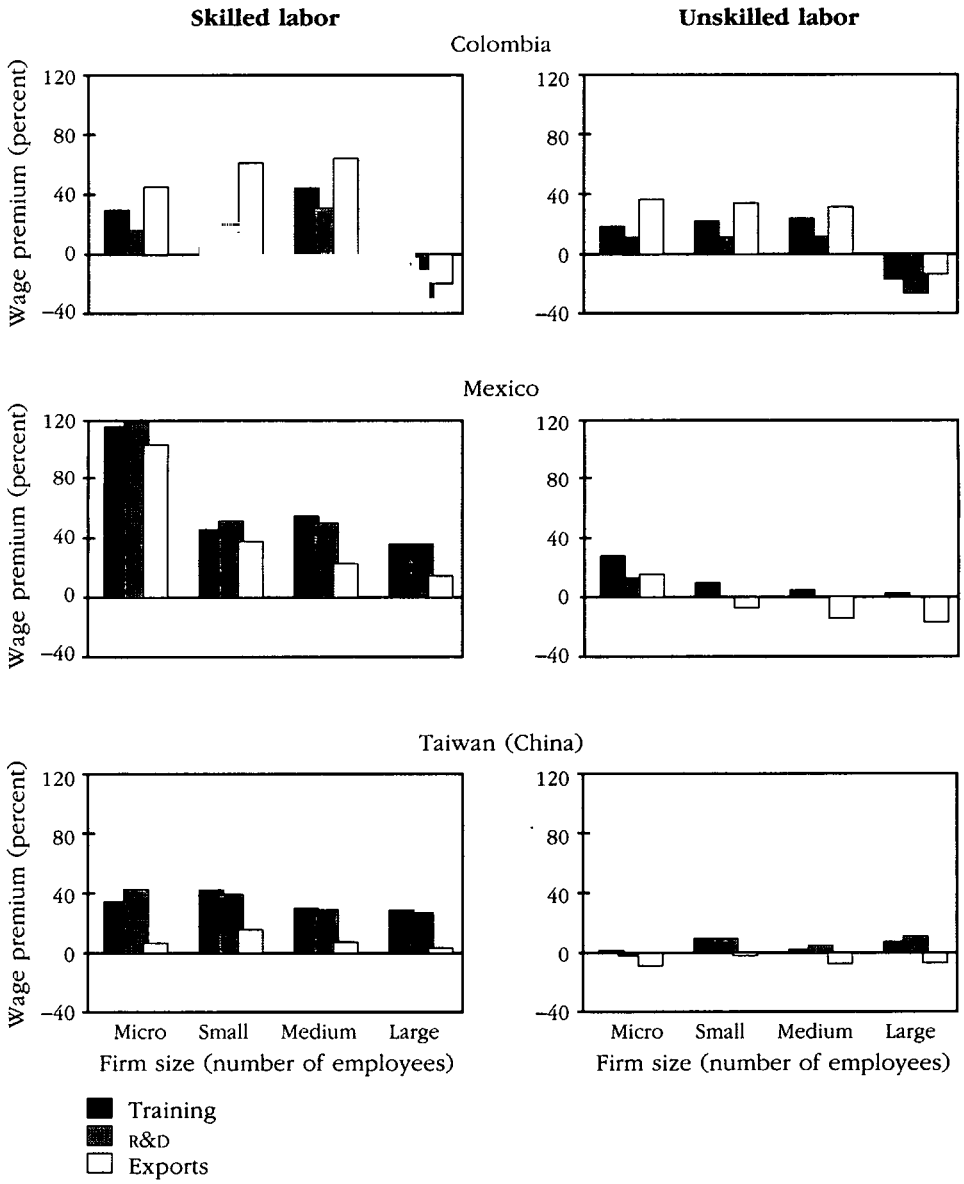
Which technology source has the largest impact on the size distribution of wages? To address this issue, we estimate semiparametric wage regressions separately for samples of firms investing in each of the three technology sources, controlling for their contemporaneous investments in the two remaining technology sources. The sample size used for each technology source varies depending on the specific source under consideration. The resulting firm size-wage distributions are compared with those of noninvestors, yielding estimates of the technology-wage premiums attributable to specific sources of technology.

Figure 4 summarizes the wage premiums for each economy by technology source and by firm size for skilled and unskilled labor. At the broadest level—the case of overall technology wage premiums—the wage premiums estimated for each technology source replicate the principal results from the aggregate measure of technology orientation. Even disaggregating by technology source, wage premiums are greater for skilled workers than for unskilled workers in all three economies. Furthermore, economy-specific patterns of technology-wage premiums by firm size remain—wage premiums are largest for the smallest size category in Mexico; they tend to rise with size (except for the largest firms) in Colombia; and they are highest in the small size category in Taiwan (China), though these size-related wage differentials are not striking. Finally, figure 4 shows that the relative importance of the three technology sources does not vary with size.

Several new results emerge when the wage premiums from each source are considered separately. First, for Mexico and Taiwan (China), table 4 shows that firm investments in R&D and worker training are the principal drivers of the

3. We acknowledge an anonymous referee for drawing our attention to this possibility.

Figure 4. *Wage Premiums by Technology Source and Firm Size, Colombia, Mexico, and Taiwan (China)*



Note: Micro firms have fewer than 16 employees, small firms have 16 to 100, medium firms have 101 to 250, and large firms have more than 250.
Source: Authors' calculations.

wage premiums paid to skilled workers by technology investors; exporting, as an informal source of technology, is relatively less important. In Mexico, compared with wages paid by noninvestors, employer investments in training are associated with a skilled worker wage premium of 76 percent, R&D and know-how investments with a premium of 74 percent, and exporting with a premium of 51 percent. In Taiwan (China) the corresponding skill wage premiums for worker training, R&D, and exports are lower—54, 51, and 22 percent, respectively—possibly because of higher levels of human capital and knowledge investments in Taiwan (China) than in Mexico. For unskilled workers the corresponding average wage premiums for worker training, R&D, and exports are 18, 13, and –2 percent, respectively, for Mexico, and 15, 17, and 2 percent, respectively, for Taiwan (China).

In Colombia, by contrast, the skill wage premiums for training or for R&D and know-how—40 and 24 percent, respectively—are dwarfed by the skill wage premiums from exporting of 61 percent. This relative ranking of the wage premiums by source persists for the unskilled worker group as well—20, 9, and 29 percent for training, R&D, and exports, respectively—though clearly the size of these premiums is smaller. We suspect that part of the explanation for the relative importance of exports lies in the high protection afforded Colombian industry, at least until recently, as compared with the relatively more open economies of Taiwan (China) and Mexico. In such a protected environment, a firm's contacts with foreign buyers and suppliers may be a more important source of best-practice technology than own R&D or training.

IV. Conclusions and Policy Implications

Unique firm-level data were used to investigate the structure of industrial wages and the role of technology in giving rise to wage differentials across firms in Colombia, Mexico, and Taiwan (China). Semiparametric methods provided a flexible tool for estimating the size distribution of wages and for disentangling the separate contributions of R&D, training, and exports on the size-wage relationship. The following findings and policy implications emerged from our cross-economy analyses.

Our cross-economy comparisons yielded two principal results. First, controlling for firm characteristics and industry, we found evidence in all three economies that firm investments in technology have a large impact on the size-wage distributions for skilled workers and a relatively smaller impact on wages paid to unskilled workers. This asymmetric wage impact of technology is consistent with the hypothesis of skill-biased technical change. Second, a decomposition of wage effects by source of technology revealed that the wage premiums paid to skilled workers are driven primarily by firm investments in R&D and training; exporting is relatively less important.

The results suggest that the large firm-size wage differentials commonly observed in many economies are primarily the outcomes of employer investments

in technology. In the extant literature, many analysts have speculated that the size and persistence of these wage differentials reflect monopoly rents from market power and imperfections in the labor market, unobserved worker attributes, or incentive wage schemes. Our findings indicate that these wage differentials reflect the returns to firm investments in technology; as such, they do not call for remedial policies to improve the working of labor markets. Though not the focus of this article, we also found large interindustry wage differentials that may reflect industry differences in technological change; this is a fruitful area for future research.

The findings also highlight striking similarities across the three economies in the wage effects of technology investments—sizable wage premiums for skilled workers, but not for unskilled workers. Compared with noninvestor firms, the overall wage premiums for skilled workers are 32 percent in Taiwan (China), 54 percent in Mexico, and 42 percent in Colombia (table 4). In contrast, the corresponding wage premiums for unskilled workers are just 7, 11, and 22 percent, respectively. This result by skill group continues to hold when the separate sources of technology—R&D, training, and exports—are considered. These differential wage effects by skill level mirror the productivity effects of training estimated within a production function framework for the same sample of firms in the three economies. We conclude that technological change is skill biased. The implication is that sustained future economic growth and technological change will depend critically upon an increased availability of educated and skilled workers.

This technology-skill complementarity also has implications for income inequality. For many developing economies, several recent trends—the accelerating pace of best practice in information and industrial technology, the increased inflows of capital and technology, and the growing integration into world markets—could create strong demand for skilled workers far outstripping the supply capacity of their educational and training institutions. Without appropriate responses from the private sector and governments, the outcome is likely to be growing income inequality between skilled and unskilled workers and between those with more and less education.

Appendix. Semiparametric and Kernel Nonparametric Estimation

Semiparametric Regression Estimation

The semiparametric regression model has the following functional form:

$$y = x'\beta + \theta(z) + u \tag{A-1}$$

where y is an $n \times 1$ vector representing the dependent variable, and n indexes firms in the sample; β is assumed to be a linear function of x, an $n \times k$ matrix of k firm attributes. The nonparametric component is represented by an $n \times 1$ vector, z. We assume that the error term u is independently and identically dis-

tributed with finite variance. In addition, $E(u/z, x) = 0$ and θ is an unknown function of z.

Since $E(y/z) = E(x/z)'\beta + \theta(z)$, equation A-1 can be rewritten as

$$y = E(y/z) + [x - E(x/z)]'\beta + u \tag{A-2}$$

where the deterministic part of y is decomposed into two parts: one is the effect on y of z, $E(y/z)$, and the other is the effect on y of x net of z, $[x - E(x/z)]'\beta$.

To obtain the coefficients of x, that is, β, we estimate $E(y/z)$ and $E(x/z)$ using a kernel nonparametric method and a smoothing parameter designed to minimize the sum of squared residuals as described below.

Kernel Nonparametric Estimation

Given the data base $[(Y_i, Z_i)/i = 1, \ldots, n]$, the nonparametric estimate of $m(z)$ is calculated as a weighted average of $g(Y_i)$, where the heavier weights are given to the observations with the z_i closest to z. That is, $m(z)$ is estimated by

$$\hat{m}(z_j) = \sum_{i=1}^{n} g(Y_i) W(z, z_i) \tag{A-3}$$

where $[W(z,z_i), i = 1, \ldots, n]$ is a sequence of weights that sums to 1. The idea is that the observations, the $g(Y_i)$s, with the z_i close to z, contain more information on $m(z)$ than observations far away from z.

The weights can be expressed as

$$W(z, z_i) = K(z - z_i)/h) / \textstyle\sum_i (K(z - z_i)/h). \tag{A-4}$$

The weighting function expressed in equation A-4 will sum to 1 for all z_i. $K(z - z_i)/h$ is called the Kernel function given by $N \sim (z,h)$. h is a positive scalar bandwidth number or smoothing parameter that determines the weights to be assigned to observations in the neighborhood of z (Hardle 1990; Delgado and Robinson 1992).

The choice of the smoothing parameter, h, plays an important role in nonparametric regression estimations, because it affects the magnitude of the weights assigned to observations in the neighborhood of z. For example, if h is too large, the observations far from z will have a large impact on the $E(y/z)$. Although it is common practice to assume an exogenous smoothing parameter, it is important that the smoothing parameter depends on the data with a view to reflecting sample size and scale of measurement. We determine the optimal smoothing parameter using least squares cross-validation techniques to determine the optimal bandwidth that gives the best fit of the nonparametrically estimated regression curve to the actual data (Hardle 1990).

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The Effects of Public Sector Hiring and Compensation Policies on the Egyptian Labor Market

Ragui Assaad

This article examines the combined impact of the employment guarantee for graduates and public sector compensation policies on the Egyptian labor market. Besides contributing to an unsustainable rate of growth in the government labor force, these policies have encouraged queuing for government jobs, contributed to high graduate unemployment rates, and reduced the employment of graduates in the private sector. Despite substantial wage erosion in the public sector in recent years, government wages, when appropriately corrected for observed heterogeneity and sample selection, are on a par with, or higher than, private sector wages, especially for graduates. When combined with the more desirable nonwage aspects of government jobs, these compensation levels explain the attractiveness of public sector employment to graduates. Government pay scales are especially advantageous to female secondary school graduates, who appear to face considerable discrimination in the private sector.

The public sector's role in shaping labor market outcomes through its hiring and compensation policies takes on special importance in Egypt because of the country's long-standing policy of guaranteeing employment in the public sector for all graduates of secondary and postsecondary institutions. When the policy was first instituted in the early 1960s, its impact was relatively limited because of the small number of eligible graduates, but, over time, it has had major consequences for the Egyptian labor market and economy.

The employment guarantee fueled the growth in demand for secondary and university education, which has, in turn, led to rapid growth in public sector employment and in the number of aspirants to such employment. When the growth of the public sector wage bill became unsustainable in the early 1980s, the government responded by eroding real public sector wages and extending the waiting period for government jobs. Despite these measures, long queues for government jobs indicate that rents received by public sector workers have not dissipated. Although the lifetime job security and many of the generous benefits

Ragui Assaad is with the Humphrey Institute of Public Affairs at the University of Minnesota. This article was originally prepared as a background paper for *World Development Report 1995: Workers in an Integrating World*. A previous version was circulated as Working Paper 9517 of the Economic Research Forum for the Arab Countries, Iran, and Turkey. The author gratefully acknowledges research assistance by Paul Stern and thanks Insan Tunali, Ishac Diwan, and three anonymous referees for their invaluable comments and suggestions.

associated with these jobs are in theory guaranteed by law, they are difficult to obtain in the private sector because of widespread noncompliance with labor regulations. Anecdotal evidence also suggests that expectations of effort and performance and tolerance of moonlighting in the public sector have adjusted to counteract at least partially the erosion of public sector wages. For example, analyzing data from Côte d'Ivoire and Peru, van der Gaag, Stelcner, and Vijverberg (1989) link a greater incidence of moonlighting with lower public sector wages.

Because of the employment guarantee for graduates and the resulting dominance of the public sector in the market for educated labor, public sector compensation policies have had a major impact on the employment and wages of graduates elsewhere in the economy. In this article, I present a Harris-Todaro-type model that predicts the major features of the market for educated labor in Egypt, namely queuing for public sector jobs, which leads to unemployment rates that are three to five times higher among graduates than nongraduates, and reduced employment of graduates in the private sector. Although graduates are overremunerated in this economy, in a static sense, the resulting excess demand for secondary and higher education results in an oversupply of educated labor and comparatively low rates of return to education by international standards. Psacharopoulos (1983) and others find that rates of return to education are generally higher in the competitive sector than in the uncompetitive sector because of the presumed equalization of pay scales in the latter. In contrast, I find that rates of return to secondary education in Egypt are higher in the public sector than in the private sector.

Section I describes the history and operation of the public sector hiring and compensation policies in Egypt. Section II examines the effects of the employment guarantee on the size and composition of the public sector labor force and on open unemployment in the economy. Section III develops a model of the market for educated labor in Egypt and presents the main findings on the effects of public sector employment and compensation policies on the wage structure and returns to education in the Egyptian labor market. Section IV concludes.

I. Public Sector Hiring and Compensation Policies

This section reviews the history and mode of operation of the graduate employment guarantee scheme, highlighting changes in the size of the program and the resulting job queue that it engendered. It also describes the government's wage-setting policy.

Historical Background of the Employment Guarantee for Graduates

As part of the extensive nationalization drive of 1961–62, the Egyptian government initiated a major public employment drive that included an employment guarantee to university graduates. In 1964 the guarantee was extended to the graduates of vocational secondary schools and technical institutes, and the

policy was formalized in Law 14 of 1964. It was later made permanent in Law 85 of 1973, which extended the employment guarantee to demobilized military conscripts of all educational levels, a provision that was abrogated in 1976 (Hansen and Radwan 1982).

The employment guarantee followed a period of rapid expansion in the number of graduates from all levels of education. (See Sanyal and others 1982 and World Bank 1989 for a detailed description of the Egyptian education system.) Primary education expanded from 1 million students in 1952 to nearly 3.5 million in 1965–66, a rate just under 9 percent a year (Richards 1992). Preparatory and secondary enrollment expanded even faster, multiplying sixfold and threefold, respectively, from 1956 to 1961. The expansion underscored the commitment of the Nasser regime to making educational opportunities more accessible to the mass of the population. However, despite the rapid growth of enrollment, the education system was starved of resources because of major increases in military spending and the demands of the state-led import-substitution drive.

In an attempt to substitute for the large number of expatriate technicians who left the country after the Suez Crisis in 1956, the government also greatly expanded access to higher education. Enrollment increased from 50,000 in 1952–53 to 97,000 in 1961–62. Combined with the abolition of fees for higher education institutions in 1963, the employment guarantee for graduates boosted the demand for education. The employment guarantee greatly enhanced the private benefits of university education, and the abolition of fees significantly lowered private costs (Richards 1992).

Operation of the Employment Guarantee Scheme

With the exception of medical graduates and teachers, whose assignment was the responsibility of the relevant ministries, the law extended to graduates the right to apply to the Ministry of Manpower and Vocational Training for a public sector job. In addition to receiving the graduates' applications, the ministry solicited requests for graduates from government agencies and state-owned enterprises. There was little incentive for these agencies to limit their requests because appointees came with a budgetary allocation to cover their salaries. Nonetheless, the requests consistently fell short of the number of applicants, presumably because the budgetary allocations did not cover the full costs of employment. The ratio of applicants to requests was 1.2 in 1977 and rose to 5.1 in 1981 (Fergany 1991a). Excess supplies of applicants were usually allocated to local authorities, which were allowed to use them at their discretion (Hansen and Radwan 1982).

Until 1978, with few exceptions, public agencies and enterprises were not allowed to hire permanent workers outside this centralized system of labor force allocation. However, many agencies circumvented this restriction by hiring workers on temporary contracts. In 1978 public enterprises were allowed to opt out of the centralized labor force allocation scheme, to set their own hiring levels, and to select their own workers. Thus, the brunt of the employment guar-

Table 1. *Number of Graduates and the Queue for Government Employment, Egypt, 1995*

Area of specialization and type of institute	*Number of graduates (by year of graduation)*			*Structure (percentage of all graduates)*	*Average annual growth rate, 1983–91 (percent)*	*Percentage of graduates still seeking government appointments (by year of graduation)*		
	1983	*1991*	*1983–91*	*1983–91*		*1983*	*1984–90*	*1991*
Area of specialization								
Health sciences	9,998	7,230	74,185	2.1	–4.1	0.2	0.7	0.8
Agriculture	8,194	8,147	72,380	2.1	–1.5	1.3	36.3	48.5
Commerce	28,441	26,293	282,434	8.1	–1.8	1.0	21.5	32.5
Engineering	8,575	7,614	78,386	2.3	–2.6	1.1	8.2	14.1
Sciences	4,370	3,625	37,792	1.1	–2.2	1.5	25.9	38.5
Law	9,562	17,848	124,308	3.6	6.9	1.4	18.3	26.7
Teacher training	15,688	22,446	203,677	5.9	2.9	0.3	0.5	4.6
Other bachelor's degrees	20,444	27,276	226,886	6.5	1.5	1.1	16.7	31.1
All universities	105,272	120,479	1,100,048	31.7	0.5	0.9	15.0	24.3
Type of institute								
Commercial technical institute	17,709	25,993	218,902	6.3	4.7	18.4	35.2	46.3
Industrial technical institute	4,622	13,015	79,022	2.3	19.2	23.5	46.8	38.7
Other technical institute	2,115	5,241	29,202	0.8	10.3	3.9	12.1	10.8
All technical institutes	24,446	44,249	327,126	9.4	8.3	17.9	34.3	39.3
Agricultural vocational secondary	22,267	35,103	251,107	7.2	5.0	60.6	51.6	38.0
Commercial vocational secondary	107,672	112,898	1,015,129	29.2	0.9	42.0	50.0	48.0
Industrial vocational secondary	58,412	131,472	779,987	22.5	11.4	58.0	48.3	29.2
All vocational secondary	188,351	279,473	2,046,223	58.9	5.4	49.2	49.1	37.9
All graduates	318,069	444,201	3,473,397	100.0	4.1	30.8	36.5	34.4

Source: Government of Egypt, Ministry of Manpower and Vocational Training.

antee fell on the government sector, which includes the central government ministries, local government authorities, and the service and economic authorities.

During the twenty-year period from the early 1960s, when the employment guarantee scheme was opened to secondary school graduates, to the early 1980s, when severe budgetary pressures resulting from a decline in oil revenues began to manifest themselves, the burden of the employment guarantee scheme on the public sector increased significantly. The number of graduates grew at about 12 percent a year from 1963 to 1983 (CAPMAS 1965, 1985), compared with an overall rate of growth of the labor force of about 2 percent a year. The rate of growth in the number of graduates has since 1983 slowed to about 4 percent a year, but graduates now constitute the bulk of new entrants to the labor market. As shown in table 1, there were about 444,000 new graduates in 1991, which compares with a net increment to the overall labor force of 360,000, at the prevailing growth rate of about 2.5 percent a year. Although the latter figure represents the net growth of the labor force rather than the number of new entrants, it leaves no doubt that graduates now constitute the majority of new entrants.

These figures show why the public sector employment guarantee to graduates has become untenable. In its attempt to respond to the growing burden, the government has avoided the outright abolition of the program. Instead it has established two policies. The first is to curtail the supply of graduates through direct rationing of enrollment by the Ministry of Education. The second is to increase the waiting period for a government appointment in the hope that some graduates will drop out of the queue.

The first policy—to limit enrollments—has significantly reduced the rate of growth in the number of graduates and shifted their composition toward specializations that are in greater demand in the private sector. The number of university graduates peaked at about 130,000 in 1986 and has been declining or stable ever since, with the decline occurring across all specializations except for law and teacher training.[1] The share of university graduates among all graduates declined from 33 percent in 1983 to 27 percent in 1991. In contrast, the number of vocational secondary school graduates grew about 5.4 percent a year over the same period, with their share increasing from 59 to 63 percent.

The mix of specializations at the vocational level has shifted strongly away from the commercial track and toward the industrial track, which has grown nearly 20 percent a year. This shift resulted from the concerted efforts of the Ministry of Education to adjust the mix of graduates in favor of the industrial track by building more of the substantially more expensive industrial secondary schools. (World Bank 1989 provides a detailed account of the changes in policy toward technical education in Egypt.) Because postsecondary technical institutes are a relatively recent addition to the Egyptian education system, their enrollment grew rapidly, at a rate of 12 percent a year, until 1987 but then

1. The statistics in this section are based on data provided by the Ministry of Manpower and Vocational Training, some of which are summarized in table 1.

slowed to 3 percent a year from 1987 to 1991. The mix of technical institute graduates also shifted significantly in favor of industrial specializations.

The second policy response—to increase the waiting period for a government job—has resulted in waiting periods of up to thirteen years. By law, university graduates must wait at least two years and secondary school and technical institute graduates must wait three years after graduation before they can apply to the Ministry of Manpower for a government job. The waiting period was designed to allow male graduates to complete their military service. With the exception of the period from 1967 to 1973, when conscripts could serve indefinitely, the duration of military service is normally one year longer for secondary and technical institute graduates than for university graduates. By 1984 the period between graduation and appointment had been extended to three and a half years for university graduates and to four years for vocational secondary and technical institute graduates; by 1987 it had been extended to five and six years, respectively (Handoussa 1989). Hiring through the centralized labor force allocation system of the Ministry of Manpower has been suspended but has not been formally abolished. As of 1995 the last cohorts of graduates who were offered appointments were the 1983 university graduates and the 1982 vocational secondary and technical institute graduates.

The Ministry of Manpower maintains a registry of applicants to public sector jobs by year of graduation. Although graduates are removed from the registry as a matter of course if they obtain a public sector job, many do not give up their position in the queue if they get a private job, thus reserving their right to a public sector job when their turn comes up. An attempt to remove graduates from the registry when they obtain a position in a formal private sector firm resulted in a mass resignation of graduates from these firms (see Assaad 1996b and "Escapees to the Public Sector" 1992). This episode, which received a lot of attention in the Egyptian press, indicates the value that graduates continue to attach to public employment.

As shown in table 1, 36.5 percent of individuals who graduated between 1984 and 1990 were still queuing for public sector jobs as of mid-1995. The queuing rates vary substantially by level of education and area of specialization. Because appointments have already been made to virtually all of the 1983 university graduates, their queuing rate is only 0.9 percent. The queuing rate increases to 24 percent for 1991 graduates. Health sciences and teacher training graduates have the lowest queuing rates because their appointments are handled directly by the relevant ministries. Some categories of university graduates, such as holders of agriculture degrees, have queuing rates well in excess of 30 percent. Overall, however, queuing rates among university graduates are substantially lower than those of vocational secondary school graduates, which approach 50 percent in some specializations. Unlike university graduates, queuing rates among vocational secondary graduates have been falling with year of graduation. This may indicate that some recent graduates are no longer bothering to register with the Ministry of Manpower because the probability of obtaining a government ap-

pointment has dwindled. The drop in queuing rates is especially noticeable for graduates from the industrial track, who are likely to be employable in the private sector.

Although the Ministry of Manpower data on graduates are not disaggregated by gender, there is considerable indirect evidence to indicate that women are much less likely to drop out of the queue than men. This can be ascertained by the fact that unemployment rates are typically much higher for female graduates than for their male counterparts (Fergany 1991b). The lower dropout rate can also be ascertained from the increasing feminization of the civil service work force (see section II).

Wage Setting in the Government Sector

Wage setting in the Egyptian government was driven by nonmarket considerations well before the institution of the graduate employment guarantee. The Law of the Price List of Educational Certificates of 1951 stipulated a fixed initial salary for each educational certificate and a system of periodic increments according to seniority and level of education, regardless of the position occupied. Basic wages in the government are still being set in this manner. Compensation levels are tied to job grades, with lower and upper bounds for each grade set according to a unified schedule. Each year the worker is entitled to a periodic increase so long as the resulting wage does not exceed the maximum for the grade. In addition to basic wages, workers can receive allowances for hazardous work, accommodation, and various other aspects of the job. The employing agency can also pay incentives for good performance. The sum total of allowances and incentives is limited to 100 percent of the basic wage. The public compensation system is laid out in articles 40 and 41 of the Civil Servants Law (Law 47 of 1978) and amended in Law 115 of 1983.

II. Effects of the Employment Guarantee Scheme

The need to absorb an ever larger number of workers every year has had major implications for the public sector's finances, performance, and size relative to the rest of the economy. Despite the abandonment of the socialist development path in 1973, public sector employment growth continued unabated in the 1970s (see El-Issawy 1983). This growth was fueled by the continuation of the employment guarantee to graduates as well as its extension to demobilized military conscripts from 1973 to 1976 (Hansen and Radwan 1982). The expansion was financed in part by the substantial increase in oil receipts flowing into public coffers after 1973.

Employment and Wages in the Government

Although it is difficult to reconcile the various sources of data on the exact size of government employment, the general trend is one of very rapid growth in the 1960s and 1970s, followed by a slowdown in the mid-1980s, when the oil

windfall of the 1970s disappeared (see El-Issawy 1983 for 1952–78 and Handoussa 1989 for the trend up to 1986). Since 1981, the Central Agency for Public Mobilization and Statistics (CAPMAS) has reported the distribution of employment by institutional sector as measured by the Labor Force Sample Survey (LFSS, see table 2). The LFSS confirms that government employment grew rapidly from 1981 to 1984 (8.4 percent a year) and then slowed markedly between 1984 and 1995 (4 percent a year), when it was still growing faster than overall employment.

Real government wages rose during the boom period of the 1970s and early 1980s but then dropped precipitously thereafter, as the government attempted to bring its finances under control. According to Zaytoun (1991), real government wages rose to a peak of 19 percent above their 1974 level in 1981 but by 1986 had fallen to nearly 60 percent of their 1981 level. Although more recent data on government wages are not readily available, real wages have probably continued to decline because cost-of-living adjustments have been kept well below the inflation rate by agreement with the International Monetary Fund.

Employment in Public Enterprises

No comprehensive series of public enterprise employment is available for the period 1960 to 1975, but Handoussa (1989) estimates that public enterprise employment grew 8.7 percent a year from 1960 to 1966 and 2.9 percent from 1966 to 1976. Data from the Public Enterprise Information Center suggest that employment grew about 5 percent a year from 1974 to 1979. In 1979 the policy allowing public enterprises to opt out of the centralized labor force allocation scheme became effective. Employment in public enterprises subsequently slowed to 1.4 percent a year from 1979 to 1986–87 (Zaytoun 1991). The more recent

Table 2. *Distribution of Employment by Institutional Sector, Egypt, Selected Years*

	Percentage of total employment					
Year	*Government*	*Public enterprises*	*Private*	*Other*[a]	*Total employment*[b] *(thousands)*	*Trend (index, 1984 = 100)*
1981	19.9	13.4	66.4	0.2	9,946	84
1984	21.4	10.8	64.9	3.0	11,819	100
1988	18.0	8.1	72.8	1.2	16,263	138
1990	22.9	10.5	65.6	1.0	14,361	122
1991	22.9	9.8	66.1	1.2	14,489	123
1992	24.2	9.8	64.9	1.1	14,399	122
1995	25.9	9.0	63.9	1.2	15,208	129

Note: Data are for the population ages twelve to sixty-four, based on the May rounds of the CAPMAS Labor Force Sample Surveys in 1981, 1984, and 1995; the October round in 1988; the December round in 1990; and the combined annual results in 1991 and 1992.

a. Includes joint ventures and foreign-owned enterprises.

b. Total employment in 1981 and 1988 is not comparable to other years because of significant methodological differences in the way female employment was measured.

Source: CAPMAS Labor Force Sample Survey (various years).

data from the LFSS, in table 2, show a slowly declining share of public enterprise employment in total employment.

Composition of Public Sector Employment

In addition to its effect on the overall size of government employment and wages, the guaranteed employment scheme has skewed the composition of public sector employment toward more graduates, most of whom are white-collar workers. It has also contributed to an increasing feminization of the government labor force because of the high likelihood that female graduates will remain in the job queue.

As shown in table 3, nearly 57 percent of male and 95 percent of female government employees are graduates (of secondary, postsecondary, or university education). The proportion in public enterprises is lower than in government, but nonetheless considerably higher than in the private sector. Graduates constitute a tiny fraction of employment in private agriculture and less than 20 percent of employment in the private nonagricultural sector. Moreover, the government sector is the largest employer of graduates, especially for females. More than two-thirds of employed females work for the government, and nearly 80 percent work for the public sector broadly defined.

The increasing feminization of the government labor force can be readily seen from table 4, which is based on a comparison of census data from 1976 and 1986. Female employment in the government has grown at a rate of 8.7 percent a year compared with 2.4 percent for males. The government sector is increasingly becoming the dominant employer of female labor, accounting for more than half of female employment in 1986. Finally, the proportion of females in the government has increased from 15 to 25 percent, considerably more than it has in other sectors.

Open Unemployment

For a country where it is virtually impossible to get unemployment benefits, Egypt's open unemployment rate of 7 to 10 percent is relatively high. The definition of open unemployment used in Egypt is a person who did not work at all, but was able and desiring to work and was searching for it, during the reference period, which is one week in the LFSS and one day in the census. In practice, graduates waiting for government jobs are considered to be actively searching for work. Most of the open unemployment is comprised of graduates and can be attributed to queuing for government jobs. As shown in table 5, graduates, particularly secondary school graduates, have made up the vast majority of the unemployed since the mid-1980s, and their share has increased over time.

The sharp increase in graduate unemployment rates between 1976 and 1986 can be attributed to the slowdown in the government hiring of graduates that occurred in the 1980s, when the waiting period was extended from between two and three years to between five and six years. The increase in graduate unemployment rates in 1987 can be discounted because of differences in definitions

Table 3. *Employment by Sector and Educational Attainment for Males and Females, Egypt, 1988*

	Males				*Females*			
Sector	*Below intermediate*	*Intermediate and above*	*University and above*	*All*	*Below intermediate*	*Intermediate and above*	*University and above*	*All*
Government	883,340	649,646	541,024	2,074,010	46,150	547,987	274,606	868,743
Public enterprise	668,155	305,737	175,429	1,149,321	36,790	95,506	40,190	172,486
Private agriculture	3,640,616	193,065	37,770	3,871,451	4,051,966	49,221	598	4,101,785
Private nonagriculture	3,154,515	513,859	276,796	3,945,170	810,798	108,298	60,874	979,970
Other	54,631	62,384	43,731	160,746	5,456	7,803	16,642	29,901
All sectors	8,401,257	1,724,691	1,074,750	11,200,698	4,951,160	808,815	392,910	6,152,885

Note: Data are for individuals ages twelve to sixty-four. Below intermediate denotes individuals who did not earn a diploma from a secondary school. Intermediate and above denotes individuals who earned a diploma from a secondary school or a two-year postsecondary technical institute. University and above denotes individuals who earned a bachelor's or master's degree at a university or other higher education institution.

Source: Calculated from CAPMAS Labor Force Sample Survey, October 1988 round.

Table 4. *Distribution of Employment by Institutional Sector and Gender, Egypt, 1976 and 1986*
(percent)

	Males			Females				
	Structure		Growth rate	Structure		Growth rate	As a percentage of total	
Sector	*1976*	*1986*	*1976–86*	*1976*	*1986*	*1976–86*	*1976*	*1986*
Government	16.0	18.2	2.4	40.7	55.9	8.7	15.4	25.5
Public enterprise	9.4	10.3	2.0	10.9	10.2	4.9	7.6	10.0
Agriculture	50.1	41.7	−0.7	23.0	10.6	−2.2	3.2	2.7
Private nonagriculture	24.4	29.9	3.1	25.4	23.3	4.7	6.9	8.0
Total	100.0	100.0	1.1	100.0	100.0	5.5	6.7	10.0
Total (thousands)	9,430	10,568	n.a.	676	1,176	n.a.	n.a.	n.a.

n.a. Not applicable.
Source: CAPMAS Population Census for 1976 and 1986.

and data collection methodologies between the population census in 1986 and the LFSS in 1987. Still, the data from 1987 to 1995 indicate an increasing trend in the rate of unemployment, accounted for primarily by the growing proportion of secondary graduates among the unemployed. These data confirm the pattern observed in section I, which indicates that vocational secondary school graduates have the highest queuing rates for government jobs. Because eligibility for the employment guarantee starts at the secondary level, the greatest labor market distortion should occur at that threshold level.

Disaggregated by gender, unemployment data reveal that female graduates are disproportionately represented among the unemployed. In 1995 women made up 50 percent of unemployed graduates but only 25 percent of employed graduates. Among secondary school graduates, the vast majority of whom graduated from vocational schools, the female unemployment rate was 50 percent compared with 23 percent for their male counterparts. The rate for female university graduates was lower (16 percent) but still considerably higher than that for male university graduates (9 percent). These results confirm that female vocational secondary school graduates, most of whom pursue the commercial track, are the least able to find employment outside the government.

III. A Model of Sector Selection and Wage Determination in Egypt

In this section, I present a simplified Harris-Todaro-type model to analyze the public sector employment guarantee and compensation policies in Egypt. I then lay out the econometric model and empirical estimates of sector-specific wage equations that take into account the simultaneous selection process into nonagricultural wage work and into the public and private sectors.

Table 5. *Distribution of Unemployed Workers and the Unemployment Rate by Educational Attainment, Egypt, Selected Years*
(percent)

Indicator and year	*Illiterate*	*Ability to read and write*	*Below intermediate*	*Intermediate*	*Above intermediate*	*University*	*All*	*Number (thousands)*
Unemployed workers								
1976[a]	27.1	12.6	9.0	38.0	2.2	11.0	100.0	513
1986[a]	14.6	6.5	4.5	52.2	5.0	17.2	100.0	1,574
1987	2.7	2.8	2.2	60.5	7.9	22.6	100.0	1,354
1990	12.9	4.1	8.4	53.3	6.8	14.6	100.0	1,345
1991	3.7	1.7	3.5	66.8	8.2	16.0	100.0	1,397
1992	1.2	1.0	1.2	70.4	9.1	17.0	100.0	1,416
1995	1.6	1.4	1.4	74.6	8.4	12.6	100.0	1,774
Unemployment rate								
1976[a]	2.5	2.5	7.0	20.6	13.5	10.9	5.0	n.a.
1986[a]	4.1	4.4	11.0	28.8	27.2	25.9	12.3	n.a.
1987	0.4	1.5	1.5	31.8	19.8	18.8	7.4	n.a.
1990	2.6	1.8	12.7	23.2	15.4	12.3	8.5	n.a.
1991	0.8	0.8	5.6	30.2	19.3	14.0	8.8	n.a.
1992	0.3	0.5	2.1	30.2	20.1	14.6	9.0	n.a.
1995	0.5	0.7	2.6	31.9	18.6	11.2	10.4	n.a.

n.a. Not applicable.

Note: Data are for individuals ages twelve to sixty-four. Data for 1987 and 1990 are from the December round of the Labor Force Sample Survey, data for 1991 and 1992 are from the combined annual results, and data for 1995 are from the May round. All are based on a one-week reference period. The ability to read and write denotes literate individuals who did not complete primary school. Below intermediate denotes individuals who earned a diploma after five years of primary school or three years of preparatory school. Intermediate denotes individuals who earned a secondary school diploma. Above intermediate denotes individuals who earned a diploma from a two-year postsecondary technical institute. University denotes individuals who earned a bachelor's or master's degree at a university or other higher education institution.

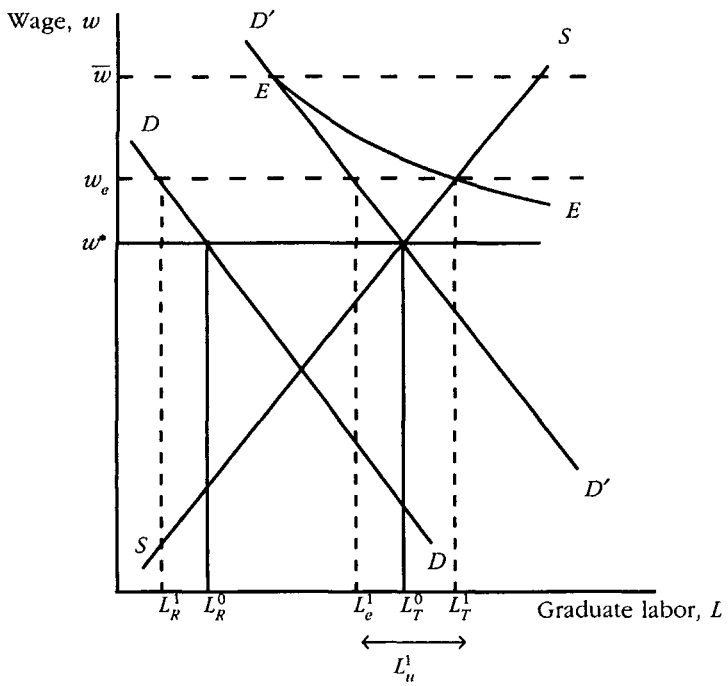
a. The data for 1976 and 1986 refer to individuals ages fifteen and above and are based on a one-day reference period.

Source: CAPMAS Population Census for 1976 and 1986. CAPMAS Labor Force Sample Survey for 1987, 1990, 1991, 1992, and 1995.

A Simple Supply and Demand Model for Educated Labor

The effect of the employment guarantee and public sector compensation policies in Egypt can be readily analyzed using a simplified Harris-Todaro-type model as follows. Consider the model shown in figure 1. Let SS be the supply curve of educated labor without the policy and DD be the private sector demand for this labor. Government employment adds a fixed amount to labor demand, shifting the demand curve to $D'D'$. If both the public and private sectors pay the market-clearing wage, the wage would be w^*, private employment would be L_R^0, and total employment would be L_T^0. There would be no graduate unemployment. Assume instead that government wage-setting practices are such that wages are set at $\overline{w}$ above the market-clearing wage w^*. Assume that each graduate has a probability p of receiving the government wage $\overline{w}$. The prevailing wage in the private sector will be the expected wage $w_e = p\overline{w}$. The probability of p employment is assumed to depend on the number of unemployed graduates L_u (or the length of the queue for government jobs) as follows: $p = f(L_u)$, where $f(0) = 1$ and $f'(L_u) < 0$; $0 \leq p \leq 1$. w_e will fall on the intersection of a rectangular hyperbola (the curve EE) and the supply curve (see Basu 1984). At wage $w_e > w^*$, private sector employment of graduates will decline to L_R^1 and unemployment will be L_u^1. Public sector employment is assumed to be invariant to the wage.

Figure 1. *Supply of and Demand for Graduate Labor in the Presence of a Public Sector Wage Floor*



If the increased demand for education at the secondary and university levels prompts the government to shift resources to these levels, the supply curve will shift outward. In that case the market clearing will be $w'^* < w^*$, and the new prevailing wage will be w'_e. Because it is not clear whether w'_e will be above or below the original market-clearing wage w^*, the policy might increase or reduce graduate wages in the long run.

As discussed in earlier sections, the Egyptian labor market exhibits all the features predicted by this simple model: a queue of unemployed graduates waiting for a government appointment and limited private sector employment of graduates. However, a direct comparison of public and private wages does not support the idea of a public sector wage floor. Average wages in the public sector appear to be substantially lower than those in the private sector and have lagged behind inflation in recent years. However, once wages are corrected for observed heterogeneity and for selectivity into the two sectors, and when the difference in nonpecuniary benefits across the two sectors is taken into account, the attraction of public sector jobs to graduates becomes readily apparent.

Econometric Model

The wage equations for male and female nonagricultural wage workers are based on a standard Mincerian human capital model. Variations in wages are assumed to be associated with differences in educational attainment and on-the-job experience. Regional variables are included to control for differences in cost-of-living and labor market conditions. Because public sector wages are not necessarily set to equal marginal productivity as assumed in the Mincerian approach, I distinguish between the two sectors by allowing each to have its own wage determination process. The public sector is defined to include the government (or civil service) and the public enterprise sector. Everything else is included in the private sector.

Several other studies have examined public-private wage differentials in developing countries (Lindauer and Sabot 1983; Corbo and Stelcner 1983; Psacharopoulos 1983; Al-Qudsi 1989). These studies do not take into consideration the endogeneity of the sectoral allocation process as is done in some of the more recent studies (van der Gaag and Vijverberg 1988; Stelcner, van der Gaag, and Vijverberg 1989; van der Gaag, Stelcner, and Vijverberg 1989; Terrell 1993). Because nonagricultural wage workers are themselves not a random sample of the population, I go a step further in this study by accounting for the endogeneity of participation in wage work in a context where self-employment is common. Tansel (1994) corrects for selectivity into wage work but does not disaggregate by sector. Vijverberg (1993) adjusts for selection into wage work (as well as other labor market states) and selection by region but does not address public-private differentials. I abstract from the issue of selection into the two components of the public sector. I assume that the wage determination process in public enterprises is identical to that in the government except for a shift parameter. Terrell (1993) takes into account nonrandom selection into the two components of the public sector. I do not take into account

endogenous selection into different levels of education. See Willis and Rosen (1979) for a discussion of the issues involved.

I use a double selection framework that extends the single selection procedures developed by Heckman (1976, 1979) and Lee (1976) to account for two selection rules jointly determining inclusion in a particular subsample. The double selection model used here, which is based on the bivariate probit technique, was developed by Tunali (1986) to analyze two consecutive migration decisions, each with two possible outcomes. Vijverberg (1993) has developed a model to deal with a similar double selection process, but in his model each decision is allowed to have more than two outcomes. Using the dichotomous variables D_1 and D_2, the two selection rules for participation in nonagricultural wage work and sector selection can be expressed as:

$$D_1 = \begin{cases} 1 \text{ participate in nonagricultural wage work if } I_1^* > 0 \\ 0 \text{ otherwise (if } I_1^* \leq 0) \end{cases}$$

$$D_2 = \begin{cases} 1 \text{ become a nonagricultural wage worker in the public sector if } I_2^* > 0 \\ 0 \text{ become a nonagricultural wage worker in the private sector if } I_2^* \leq 0 \end{cases}$$

where I_1^* and I_2^* are latent variables indicating the difference in the worker's utility between nonagricultural wage work and other labor market states and between public and private nonagricultural wage work, respectively. The decisions are not necessarily sequential. The methodology used allows for the two decisions to be simultaneous. The worker's utility in each sector takes into account both pecuniary and nonpecuniary aspects of participation in each sector as well as noncompetitive barriers to entry, which can take the form of waiting queues or other costs of entry.

Omitting subscripts indicating a particular individual, the latent variables can be written as a linear function of observable characteristics and an error term as follows:

$$I_1^* = \gamma_1 \mathbf{Z} + \varepsilon_1 \tag{1}$$

$$I_2^* = \gamma_2 \mathbf{Z} + \varepsilon_2 \tag{2}$$

where $\mathbf{Z}$ is a vector of individual characteristics; γ_1 and γ_2 are vectors of unknown parameters; and ε_1 and ε_2 are zero-mean, constant-variance disturbance terms. Because I_1^* and I_2^* are not observed, but sector selection is, equations 1 and 2 can be estimated as a system of two dichotomous dependent-variable equations.

The wage equations in the public and private sectors are specified according to the standard Mincerian human capital model, where log wages y are assumed to depend on human capital characteristics and regional labor market and cost-of-living differences as follows:

$$y_P = \beta_{0P} + \beta_P \mathbf{X}_P + \nu_P \tag{3}$$

$$y_R = \beta_{0R} + \beta_R \mathbf{X}_R + \nu_R. \tag{4}$$

X_P and X_R are vectors of characteristics for workers in the public and private sectors, respectively; β_{0P} and β_{0R} are the two intercepts; and β_P and β_R are vectors of unknown parameters other than the intercept. The vector of disturbances $U = (\varepsilon_1, \varepsilon_2, v_P v_R)$ is assumed to have a multivariate normal distribution with zero means and covariance matrix Σ. With the usual standardization of the unidentifiable variances of the dichotomous dependent-variable models, Σ is given by:

$$\Sigma = \begin{bmatrix} 1 & \rho_{12} & \rho_{1P}\sigma_P & \rho_{1R}\sigma_R \\ \rho_{12} & 1 & \rho_{2P}\sigma_P & \rho_{2R}\sigma_R \\ \rho_{1P}\sigma_P & \rho_{2P}\sigma_P & \sigma_P^2 & \rho_{PR}\sigma_P\sigma_R \\ \rho_{1R}\sigma_R & \rho_{2R}\sigma_R & \rho_{UP}\sigma_P\sigma_R & \sigma_R^2 \end{bmatrix}.$$

The system of equations 1–4 and the covariance matrix can be estimated by Heckman-Lee-type two-stage methods, keeping in mind that σ_{PR} cannot be identified because only one regime is observed for each person.[2] The expected values of log wages in the public and private sectors are given by:

$$(5) \qquad \begin{aligned} E(y_P) &= \beta_{0P} + \beta_P X_P + E(v_P \mid D_1 = 1, D_2 = 1) \\ &= \beta_{0P} + \beta_P X_P + \rho_{1P}\sigma_P\lambda_{1P} + \rho_{2P}\sigma_P\lambda_{2P} \end{aligned}$$

$$(6) \qquad \begin{aligned} E(y_R) &= \beta_{0R} + \beta_R X_R + E(v_R \mid D_1 = 1, D_2 = 0) \\ &= \beta_{0R} + \beta_R X_R + \rho_{1R}\sigma_R\lambda_{1R} + \rho_{2R}\sigma_R\lambda_{2R} \end{aligned}$$

where

$$(7) \qquad \begin{aligned} \lambda_{1P} &= \frac{f(\theta_1)F(\theta_2^*)}{G(\theta_1, \theta_2; \rho_{12})}, & \lambda_{2P} &= \frac{f(\theta_2)F(\theta_1^*)}{G(\theta_1, \theta_2; \rho_{12})} \\ \lambda_{1R} &= \frac{f(\theta_1)F(-\theta_2^*)}{G(\theta_1, -\theta_2; -\rho_{12})}, & \lambda_{2R} &= \frac{f(\theta_2)F(\theta_1^*)}{G(\theta_1, -\theta_2; -\rho_{12})} \end{aligned}$$

$f(.)$ and $F(.)$ denote the standard univariate normal-density and distribution functions, respectively; $G(\,.\,,\,.\,;\rho)$ denotes the standard bivariate normal distribution function, with correlation ρ; and $\theta_1, \theta_2, \theta_1^*$ and θ_2^* are given by

$$\begin{aligned} \theta_1 &= \gamma_1 Z, & \theta_2 &= \gamma_2 Z \\ \theta_1^* &= \frac{\theta_1 - \rho_{12}\theta_2}{(1-\rho_{12}^2)^{1/2}}, & \theta_2^* &= \frac{\theta_2 - \rho_{12}\theta_1}{(1-\rho_{12}^2)^{1/2}}. \end{aligned}$$

The first stage consists of a simultaneous estimation of the two selection equations using the bivariate probit technique. The parameter estimates are used to

2. Two-stage methods provide estimates for $\lambda_{ij} = \rho_{ij}\,\sigma_j$ (where $i = 1, 2$; $j = P, R$) rather than for ρ_{ij} and σ_j separately.

compute the λ terms as in expression 7, which are then included as regressors in the second-stage wage equations. The standard errors of the second stage are adjusted to account for the presence of estimated regressors. The expression for an asymptotic covariance matrix is provided in Tunali (1986).

Empirical Analysis

The data are obtained from the October 1988 round of the Egyptian LFSS. This special round of the survey used a more detailed set of questions to inquire about earnings than is usual in the regular rounds of the survey.[3] As a result, data on monetary earnings appear to be fairly reliable. Although an attempt was made to get at earnings in kind, the quality of that data appears to be poor. I therefore use monetary net earnings and divide by the number of hours worked per year to compute the hourly wage. The most important nonpecuniary benefits thus excluded are the value of retirement and death benefits for workers who are covered by social insurance and the value of job security for those who possess legal employment contracts. The vast majority of public sector workers have social insurance coverage and work under legal employment contracts, but only 26 percent of private nonagricultural workers have social insurance coverage and only 12 percent have legal contracts. (See Assaad 1996b for a description of Egypt's job security and social insurance system.)

Because participation in the labor force for working-age males is virtually universal, there is no need to model the labor force participation decision. Thus, the relevant universe for participation in the nonagricultural wage work decision for males is all males ages fifteen to sixty-four who were in the labor force some time during the reference year. In the case of females, however, the participation equation models the outcome of both the decision to participate in the labor force and the decision to participate in nonagricultural wage work, so that the relevant universe is all females ages fifteen to sixty-four.

Summary statistics for the variables used in the wage and selection equations are shown in table 6. Nearly 50 percent of males in the relevant universe are nonagricultural wage workers, and among those nearly 60 percent are in the public sector (see the last line in table 6). The information on parent background, which is used in one of the male selection equations, was only collected for half the households in the sample. The male subsample used here is therefore drawn from these households. The proportion of nonagricultural wage workers in the female sample is 10 percent, but among those a larger share works in the public sector (77 percent).

An examination of the mean wage data reveals why public sector jobs have such a strong appeal for women who choose to work for wages. While the gender gap in average wages is large in the private sector (0.37 log points), it is much narrower in the public sector (0.07 log points). The gender gap in the private sector does not appear to be related to differences in work force composition.

3. The earnings module was designed by Professor Mohaya Zaytoun and is described in detail in Zaytoun (1990).

Table 6. *Mean Values for Variables by Gender and Labor Force Status, Egypt, 1988*

	Males[a]			*Females*		
	Nonagricultural wage workers			*Nonagricultural wage workers*		
Variable	*Public*	*Private*	*Others*[b]	*Public*	*Private*	*Others*[c]
Log hourly wage	−0.477	−0.586	n.a.	−0.551	−0.955	n.a.
	(0.630)	(0.703)	n.a.	(0.591)	(0.707)	n.a.
Age	39.3	28.2	35.5	32.6	27.7	33.1
	(10.3)	(10.9)	(15.1)	(8.6)	(10.3)	(13.8)
Experience	19.7	12.8	n.a.	10.5	6.8	n.a.
	(11.7)	(10.9)	n.a.	(8.7)	(9.0)	n.a.
Educational attainment						
Illiterate (reference)	0.146	0.307	0.482	0.033	0.304	0.649
	(0.353)	(0.461)	(0.500)	(0.179)	(0.460)	(0.477)
Ability to read and write♦	0.182	0.183	0.165	0.014	0.060	0.082
	(0.386)	(0.387)	(0.371)	(0.116)	(0.237)	(0.274)
Primary♦	0.076	0.106	0.087	0.018	0.054	0.057
	(0.265)	(0.307)	(0.282)	(0.132)	(0.226)	(0.232)
Preparatory♦	0.054	0.137	0.090	0.025	0.088	0.086
	(0.226)	(0.344)	(0.286)	(0.157)	(0.283)	(0.280)
General secondary♦	0.032	0.039	0.035	0.025	0.028	0.033
	(0.176)	(0.194)	(0.183)	(0.155)	(0.166)	(0.179)
Vocational secondary♦	0.215	0.144	0.074	0.449	0.267	0.055
	(0.411)	(0.352)	(0.262)	(0.498)	(0.443)	(0.229)
Vocational secondary, blue collar♦	0.031	0.097	n.a.	0.014	0.071	n.a.
	(0.172)	(0.296)	n.a.	(0.116)	(0.257)	n.a.
Vocational secondary, white collar♦	0.185	0.048	n.a.	0.436	0.196	n.a.
	(0.388)	(0.214)	n.a.	(0.496)	(0.398)	n.a.
Technical institute♦	0.060	0.020	0.013	0.143	0.037	0.007
	(0.237)	(0.141)	(0.115)	(0.350)	(0.189)	(0.085)
All baccalaureate degrees♦	0.201	0.060	0.049	0.275	0.159	0.030
	(0.401)	(0.238)	(0.216)	(0.447)	(0.366)	(0.171)
Bachelor of medicine♦	0.013	0.001	0.003	0.018	0.014	0.001
	(0.113)	(0.028)	(0.055)	(0.132)	(0.119)	(0.030)
Bachelor of agriculture♦	0.025	0.002	0.006	0.017	0.009	0.001
	(0.157)	(0.049)	(0.079)	(0.129)	(0.092)	(0.033)
Bachelor of engineering♦	0.025	0.015	0.006	0.013	0.003	0.001
	(0.157)	(0.123)	(0.075)	(0.112)	(0.053)	(0.033)
Bachelor of sciences♦	0.009	0.003	0.002	0.010	0.014	0.010
	(0.097)	(0.057)	(0.045)	(0.100)	(0.119)	(0.031)
Bachelor of commerce♦	0.053	0.024	0.014	0.069	0.043	0.006
	(0.223)	(0.154)	(0.118)	(0.254)	(0.202)	(0.076)
Bachelor of law♦	0.015	0.005	0.007	0.013	0.006	0.002
	(0.123)	(0.070)	(0.084)	(0.112)	(0.075)	(0.044)
Other baccalaureate degree♦	0.060	0.009	0.011	0.136	0.071	0.009
	(0.238)	(0.094)	(0.104)	(0.343)	(0.257)	(0.097)
Postgraduate♦	0.035	0.004	0.004	0.019	0.003	0.001
	(0.183)	(0.064)	(0.066)	(0.135)	(0.053)	(0.028)
Region of residence						
Greater Cairo (reference)	0.288	0.368	0.129	0.353	0.520	0.211
	(0.453)	(0.482)	(0.336)	(0.478)	(0.500)	(0.408)
Alexandria and Suez Canal♦	0.123	0.123	0.069	0.157	0.145	0.088
	(0.328)	(0.328)	(0.254)	(0.364)	(0.352)	(0.283)
Urban Lower Egypt♦	0.141	0.160	0.122	0.195	0.105	0.134
	(0.348)	(0.367)	(0.327)	(0.396)	(0.307)	(0.341)

Table 6. *(continued)*

	Males[a]			Females		
	Nonagricultural wage workers			Nonagricultural wage workers		
Variable	*Public*	*Private*	*Others*[b]	*Public*	*Private*	*Others*[c]
Urban Upper Egypt♦	0.130	0.085	0.087	0.129	0.068	0.095
	(0.367)	(0.279)	(0.283)	(0.335)	(0.252)	(0.293)
Rural Lower Egypt♦	0.198	0.175	0.355	0.125	0.125	0.283
	(0.398)	(0.380)	(0.479)	(0.331)	(0.331)	(0.450)
Rural Upper Egypt♦	0.120	0.089	0.237	0.041	0.037	0.190
	(0.326)	(0.285)	(0.425)	(0.197)	(0.189)	(0.392)
Public enterprise♦	0.343	n.a.	n.a.	0.157	n.a.	n.a.
	(0.475)	n.a.	n.a.	(0.364)	n.a.	n.a.
Father's predominant employment status						
Father self-employed♦	0.469	0.369	0.635	n.a.	n.a.	n.a.
	(0.499)	(0.483)	(0.481)	n.a.	n.a.	n.a.
Household-related variables						
Currently married♦	0.820	0.429	0.642	0.673	0.281	0.638
	(0.384)	(0.495)	(0.479)	(0.469)	(0.450)	(0.481)
Household head♦	0.749	0.377	0.525	0.095	0.094	0.099
	(0.434)	(0.485)	(0.499)	(0.293)	(0.292)	(0.299)
Male household earnings	n.a.	n.a.	n.a.	1.63	1.35	0.961
(thousands of Egyptian						
pounds)	n.a.	n.a.	n.a.	(1.99)	(2.14)	(1.42)
Self-employed males♦	n.a.	n.a.	n.a.	0.136	0.224	0.388
	n.a.	n.a.	n.a.	(0.343)	(0.418)	(0.487)
Male private wage	n.a.	n.a.	n.a.	0.144	0.324	0.221
workers♦	n.a.	n.a.	n.a.	(0.351)	(0.469)	(0.415)
Male public wage	n.a.	n.a.	n.a.	0.598	0.304	0.310
workers♦	n.a.	n.a.	n.a.	(0.490)	(0.461)	(0.462)
Sample selection terms[d]						
Wage work selection, λ_{1j}	0.557	0.798	n.a.	0.858	25.7	n.a.
	(0.303)	(0.358)	n.a.	(0.496)	(55.4)	n.a.
Public-private	0.444	−0.610	n.a.	0.254	−14.4	n.a.
selection, λ_{2j}	(0.368)	(0.486)	n.a.	(0.291)	(35.8)	n.a.
Number of						
observations	1,694	1,232	2,991	1,180	352	14,257

n.a. Not applicable.

Note: Standard deviations are in parentheses. The ability to read and write denotes literate individuals who did not complete primary school. Primary denotes individuals who earned a diploma after five years of primary school. Preparatory denotes individuals who earned a diploma after three years of preparatory school. General secondary denotes individuals who earned a diploma from a three-year secondary school that leads to the higher education system. Vocational secondary denotes individuals who completed a three-year vocational track. Technical institute denotes individuals who earned a diploma from a two-year postsecondary technical institute.

a. The male subsample is derived from a random sample of half of the households in the overall sample.

b. Includes all other males ages fifteen to sixty-four who were in the labor force at some point during the reference year.

c. Includes all other females ages fifteen to sixty-four.

d. The subscript $j = (P, R)$ denotes the relevant sectoral wage equation.

♦ Indicates a dummy variable.

Source: Author's calculations based on data from the Labor Force Sample Survey for 1988.

Female nonagricultural wage workers in both sectors are generally better educated than their male counterparts. Nearly 50 percent of female private sector workers hold a secondary diploma or above, compared with 27 percent of their male counterparts.

Female nonagricultural wage workers also tend to be more concentrated in the large metropolitan areas of Cairo and Alexandria, where social norms are more permissive of women's work outside the home. Judging from the higher proportion of married women in the public sector, it appears that after marriage women are much more likely to stay in their public sector jobs than in private sector wage work. There is also a high correlation between a woman's labor force status and the status of other members of her household. Women with male public sector workers in the household are more likely to be in the public sector, and those with male private sector workers in the household are more likely to be observed in the private sector. The presence of a family business, which is proxied here by the father's employment status, appears to be positively correlated with self-employment for males. Finally, it is worth noting that 34 percent of male and 16 percent of female public sector workers are employed in public enterprises rather than the civil service.

First-stage estimates: the selection equations. Table 7 shows the parameter estimates from bivariate probit estimation of the two selection equations for males and females. The first selection equation describes the individual's decision about whether to participate in nonagricultural wage work. The second models the selection process into the public and private sectors for workers selected into the nonagricultural wage work subsample. For males, the participation decision amounts primarily to a choice between nonagricultural wage work and self-employment or agricultural wage work. The observable characteristics that affect that choice are essentially the same as those that determine the choice between the public and private sectors, namely age, education, and region of residence. Marital and household headship status are also likely to affect both decisions. It is not clear what the effect of headship on either decision should be a priori. The effect of marital status on the participation decision of males is also not clear a priori, but married men are more likely to prefer the public sector, other things being equal, because it provides greater income security.

In bivariate selection models such as this one, where one of the cells of the classification is censored (the outcome of the sector selection is only observed for individuals who participate in nonagricultural wage work), at least one restriction is needed for identification (Tunali 1986). The father's self-employment status, which is meant to proxy the presence of a family business, is likely to affect the choice of self-employment or wage work, but not the choice of sector. There are therefore good theoretical reasons to exclude that variable from the sector selection equation.

Because of the strong link between female labor force participation and household responsibilities, the number of children in various age groups and the pres-

ence of elderly parents or alternative caregivers in the household are sometimes included as regressors in the participation equation (see the survey in Killingsworth and Heckman 1986). Because these variables are potentially endogenous to a woman's decision to work, I do not include them in this reduced-form equation. However, I do include variables relating to the labor force status and earnings of male members of the household. In theory, other household members' decisions about whether and how to participate in the labor force may be endogenous to the woman's decision. In the Egyptian context, it is unlikely that males decide their labor force status as a function of that of their wives, sisters, or daughters. The presence in the household of males who are private or public wage workers should be positively associated with a woman's participation in wage work because of the labor market information it provides. The presence of self-employed males in the household would be positively associated with employment in a family enterprise and therefore negatively associated with a woman's participation in wage work. In addition, a woman's choice of sectors would be positively associated with that of her male relatives. In the absence of information on unearned or property income in the survey, I use male wage earnings to model the income effect on participation. Because data are only available for wage earnings, the income effect from self-employment earnings is captured by the dummy variable "male self-employed workers." This variable and the "male household earnings" variable are excluded from the female sector selection equation and thus serve to identify the model.

Because of the employment guarantee scheme for graduates, educational attainment is an important determinant of both sectoral choice and participation in wage work. Furthermore, because some educational specializations at the bachelor's level lead to a greater likelihood of being in the liberal professions and therefore of being self-employed, I use a more detailed breakdown of educational specializations than is typical in standard human capital models. The results confirm the importance of educational attainment as a determinant of both selection processes. As expected, there is a significant increase in the probability of joining the government for vocational secondary, technical institute, and university graduates, the groups covered by the employment guarantee. The increase at those levels is especially pronounced for females. The other variables discussed above seem to have the expected signs. Descriptive statistics of the λ terms calculated from the first stage are shown in table 6.

Second-stage estimates: the wage equations. Separate wage equations are estimated for males and females. Experience is calculated as the total number of years since entering the labor force, thus neglecting any time spent outside the labor force since entry. Because the number of years of schooling is not available from the survey, education is specified as the attainment of particular educational credentials. The "read and write" variable—literate individuals—is clearly an exception to this rule. (See van der Gaag and Vijverberg 1989 for a comparison of the credentials and years of schooling approaches to measuring human capital.)

Table 7. *Estimation Results for the Selection Equations, Egypt, 1988*

	Males		*Females*	
Variable	*Participation in nonagricultural wage work*	*Public-private selection decision*	*Participation in nonagricultural wage work*	*Public-private selection decision*
Constant	−1.470***	−5.76***	−5.24***	−4.59**
	(−8.47)	(−13.1)	(−25.9)	(−2.02)
Age	0.100***	0.212***	0.201***	0.192**
	(9.61)	(10.4)	(16.0)	(2.42)
$Age^2/100$	−0.140***	−0.203***	−0.254***	−0.219**
	(−11.2)	(−7.47)	(−15.2)	(−2.15)
Educational attainment[a]				
Ability to read and write	0.476***	0.488***	0.148*	0.479*
	(9.24)	(4.72)	(1.78)	(1.74)
Primary	0.446***	0.771***	0.610***	1.06***
	(6.68)	(6.09)	(7.13)	(2.74)
Preparatory	0.514***	0.789***	0.719***	0.868**
	(7.36)	(5.90)	(8.94)	(2.25)
General secondary	0.371***	0.800***	0.704***	1.050**
	(3.89)	(3.81)	(6.77)	(2.40)
Vocational secondary	0.895***	1.35***	2.03***	1.66**
	(14.70)	(10.1)	(36.9)	(2.21)
Technical institute	0.878***	1.63***	2.46***	1.98**
	(7.78)	(8.98)	(27.4)	(2.32)
Bachelor of medicine	0.677***	2.61***	2.40***	1.16
	(3.00)	(4.70)	(11.7)	(1.39)
Bachelor of agriculture	0.740***	2.05***	2.12***	1.28
	(4.26)	(4.69)	(9.94)	(1.51)
Bachelor of engineering	0.769***	1.06***	1.91***	1.83**
	(4.49)	(5.49)	(7.82)	(2.06)
Bachelor of science	0.725***	1.74***	2.11***	1.08
	(2.86)	(4.15)	(8.39)	(1.27)
Bachelor of commerce	0.713***	1.21***	1.99***	1.35*
	(6.25)	(6.91)	(18.2)	(1.86)
Bachelor of law	0.446**	1.46***	1.58***	1.78**
	(2.55)	(3.70)	(7.84)	(2.23)
Other bachelor	1.02***	1.98***	2.18***	1.42*
	(8.09)	(9.26)	(25.6)	(1.87)
Postgraduate	0.995***	1.70***	2.39***	1.65*
	(5.89)	(6.82)	(9.83)	(1.83)
Region of residence[b]				
Alexandria and Suez Canal	−0.168**	0.222**	0.016	0.367***
	(−2.47)	(2.47)	(0.29)	(2.75)
Urban Lower Egypt	−0.327***	0.227**	−0.077	0.610***
	(−5.52)	(2.12)	(−1.32)	(4.35)
Urban Upper Egypt	−0.308***	0.474***	−0.071	0.726***
	(−4.72)	(3.76)	(−1.08)	(4.07)
Rural Lower Egypt	−0.680***	0.444***	−0.184***	0.497***
	(−12.7)	(2.95)	(−3.05)	(2.68)
Rural Upper Egypt	−0.813***	0.574***	−0.355***	0.584**
	(−13.6)	(3.18)	(−4.31)	(2.27)

Table 7. *(continued)*

Variable	Males: Participation in nonagricultural wage work	Males: Public-private selection decision	Females: Participation in nonagricultural wage work	Females: Public-private selection decision
Father's predominant employment status				
Father self-employed or employer	−0.384***			
	(−10.5)			
Household-related variables				
Head of household	0.250***	−0.002	0.044	0.352*
	(4.26)	(−0.02)	(0.64)	(1.69)
Currently married	−0.003	0.266***	−0.481***	0.379**
	(−0.04)	(2.77)	(−9.72)	(2.13)
Male household earnings			−0.009	
			(−0.66)	
Self-employed males			−0.343***	
			(−7.12)	
Male private wage workers			0.046	−0.167
			(0.93)	(−1.50)
Male public wage workers			0.142***	0.305***
			(2.75)	(2.50)
ρ_{12}^{c}	0.152		−0.170	
	(0.60)		(−0.44)	
Log-likelihood	−4,726.3		−3,376.9	
Number of observations	5,917		15,789	

Note: Values are bivariate probit estimates. *t*-ratios are in parentheses. The ability to read and write denotes literate individuals who have not completed primary school. Primary denotes individuals who earned a diploma after five years of primary school. Preparatory denotes individuals who earned a diploma after three years of preparatory school. General secondary denotes individuals who earned a diploma from a three-year secondary school that leads to the higher education system. Vocational secondary denotes individuals who completed a three-year vocational track. Technical institute denotes individuals who earned a diploma from a two-year postsecondary technical institute.

* Indicates significance at the 10 percent level.

** Indicates significance at the 5 percent level.

*** Indicates significance at the 1 percent level.

a. Illiterate is the reference category.

b. Greater Cairo is the reference category.

c. Correlation of the disturbances of the two selection equations (ε_1 and ε_2).

Source: Author's calculations.

The wage equation estimates are shown in table 8. The coefficient for the public enterprise dummy variable indicates that public enterprise workers earn between 20 and 28 percent more than government workers on average. Public enterprises have had some autonomy in setting their compensation levels and have apparently been more successful than the government in keeping them in line with inflation. Zaytoun (1991) reports that although average wages in public enterprises were roughly equal to those in government up to the late 1970s, government wages increasingly fell behind in the 1980s.

As shown in table 8, the wage work selection term is insignificant, except for public sector males, where it is barely significant at the 10 percent level. Thus,

Table 8. *Estimation Results for the Wage Equations, Egypt, 1988*

	Males		*Females*	
Variable	*Public*	*Private*	*Public*	*Private*
Constant	−1.630***	−0.904***	−1.425***	−1.701***
	(−13.85)	(−6.68)	(−7.08)	(−4.93)
Experience	0.042***	0.050***	0.051***	0.025**
	(9.85)	(7.10)	(9.21)	(2.23)
Experience^2/100	−0.045***	−0.097***	−0.054***	−0.036
	(−5.07)	(−6.56)	(−3.29)	(−1.36)
Educational attainment[a]				
Ability to read and write	0.194***	−0.064	−0.063	−0.016
	(3.93)	(−0.93)	(−0.53)	(−0.10)
Primary	0.290***	−0.002	0.097	0.078
	(4.86)	(−0.02)	(0.82)	(0.46)
Preparatory	0.436***	−0.006	0.269**	0.068
	(6.58)	(−0.07)	(2.40)	(0.46)
General secondary	0.769***	0.070	0.548***	0.465**
	(9.61)	(0.63)	(4.52)	(2.08)
Vocational secondary, blue collar	0.785***	0.187*	0.317*	0.256
	(8.81)	(1.72)	(1.88)	(1.10)
Vocational secondary, white collar	0.723***	0.057	0.456***	0.069
	(10.8)	(0.47)	(3.35)	(0.31)
Technical institute	0.863***	0.145	0.550***	−0.018
	(10.7)	(0.88)	(3.61)	(−0.06)
University	1.06***	0.401***	0.803***	0.819***
	(14.7)	(2.93)	(5.72)	(3.49)
Increment for engineering	0.182**	0.607***	0.083	0.219
	(2.27)	(3.66)	(0.76)	(0.35)
Postgraduate	1.39***	0.811***	1.13***	1.154*
	(15.0)	(2.86)	(6.62)	(1.77)
Region of residence[b]				
Alexandria and Suez Canal	−0.143***	0.031	−0.148***	−0.173*
	(−3.43)	(0.49)	(−3.91)	(−1.69)
Urban Lower Egypt	−0.184***	−0.083	−0.099***	−0.430***
	(−4.34)	(−1.29)	(−2.59)	(−3.56)
Urban Upper Egypt	−0.163***	−0.162**	−0.147***	−0.533***
	(−3.52)	(−1.99)	(−3.89)	(−3.54)
Rural Lower Egypt	−0.360***	−0.048	−0.191***	−0.350***
	(−7.05)	(−0.56)	(−4.13)	(−2.87)
Rural Upper Egypt	−0.323***	−0.011	−0.263***	−0.505***
	(−5.27)	(−0.11)	(−3.61)	(−2.44)
Public enterprise	0.245***		0.181***	
	(9.30)		(5.00)	
Sample selection terms[c]				
Wage work selection, λ_1,	0.162*	−0.188	0.011	0.205
	(1.90)	(−1.57)	(0.15)	(1.51)
Public-private selection, λ_2,	−0.066	−0.129*	−0.219**	−0.348***
	(−1.18)	(−1.64)	(−2.37)	(−2.68)

Table 8. *(continued)*

Variable	Males		Females	
	Public	*Private*	*Public*	*Private*
Correlation ρ_{1j}[d]	0.334	−0.306	0.025	0.221
Correlation ρ_{2j}[e]	−0.135	−0.210	−0.518	−0.375
R^2	0.446	0.218	0.528	0.304
Number of observations	1,694	1,232	1,180	352

Note: Values are selectivity-corrected estimates obtained using the bivariate probit sample selection technique. The dependent variable is log hourly wage. *t*-ratios are in parentheses. The ability to read and write denotes literate individuals who did not complete primary school. Primary denotes individuals who earned a diploma after five years of primary school. Preparatory denotes individuals who earned a diploma after three years of preparatory school. General secondary denotes individuals who earned a diploma from a three-year secondary school that leads to the higher education system. Vocational secondary denotes individuals who completed a three-year vocational track. Technical institute denotes individuals who earned a diploma from a two-year postsecondary technical institute.

* Indicates significance at the 10 percent level.

** Indicates significance at the 5 percent level.

*** Indicates significance at the 1 percent level.

a. Illiterate is the reference category.

b. Greater Cairo is the reference category.

c. The subscript $j = (P, R)$ denotes the relevant sectoral wage equation.

d. ρ_{1j} is the correlation of the error term of the wage work selection equation with that of the relevant wage equation ($j = P, R$).

e. ρ_{2j} is the correlation of the error term of the public-private selection equation with that of the relevant wage equation.

Source: Author's calculations.

there is little evidence of selectivity bias due to nonrandom selection into nonagricultural wage work. The public-private selection terms are marginally significant for private sector males, but highly significant and negative for females in both sectors. The observed pattern of the error terms in both wage equations being negatively correlated with the error term in the selection equation ($\rho_{2P} < 0$, $\rho_{2R} < 0$) can be interpreted as follows: workers who select the public sector are below average quality and those who select the private sector are above average quality. This interpretation depends on the assumption that pay is related to unobserved worker quality in both sectors. Even though public sector pay is rather insensitive to performance, managers are sometimes able to reward good performance with occasional incentive payments and bonuses. The selection pattern is consistent with the idea that the queue results in adverse selection into the public sector as the more motivated workers are the first to find private sector work and drop out of the queue.

Predicted wages by sector and gender are shown in table 9. There appears to be no difference in the returns to experience for recent entrants between males in the public and in the private sectors, but the private sector wage-experience profile has a sharper curvature; male wages actually begin to decline within the relevant range of experience. This difference is probably caused by the greater

Table 9. *Predicted Wages by Institutional Sector and Gender, Egypt, 1988*
(Egyptian pounds per hour)

Experience and educational attainment	*Males*		*Females*	
	Government[a]	*Private*	*Government*[a]	*Private*[b]
Experience[c]				
Five years	0.49	0.54	0.48	0.22
Fifteen years	0.69	0.74	0.73	0.26
Twenty-five years	0.88	0.83	0.98	0.29
Thirty-five years	1.03	0.76	1.19	0.30
Educational attainment[d]				
Illiterate	0.34	0.69	0.46	0.25
Ability to read and write	0.41	0.65	0.43	0.24
Primary	0.45	0.69	0.51	0.27
Preparatory	0.52	0.69	0.60	0.26
General secondary	0.72	0.74	0.80	0.39
Vocational secondary, blue collar	0.73	0.84	0.63	0.32
Vocational secondary, white collar	0.69	0.74	0.73	0.26
Technical institute	0.79	0.80	0.80	0.24
Engineering baccalaureate	1.16	1.90	1.12	0.69
Other baccalaureate	0.96	1.04	1.03	0.56
Postgraduate	1.35	1.56	1.42	0.78
Number of observations	1,694	1,232	1,180	352

Note: Predictions are based on the wage equation estimates (see table 8). The predicted wages are computed as the antilog of $X'\beta$ without the λ-terms, which means that they are the expected wage in each sector for a randomly selected individual from the population. The Xs are the characteristics of a reference worker who lives in Greater Cairo, is not currently married, and is not a head of household. The reference public sector worker is a government employee. For the educational attainment categories, the ability to read and write denotes literate individuals who did not complete primary school. Primary denotes individuals who earned a diploma after five years of primary school. Preparatory denotes individuals who earned a diploma after three years of preparatory school. General secondary denotes individuals who earned a diploma from a three-year secondary school that leads to the higher education system. Vocational secondary denotes individuals who completed a three-year vocational track. Technical institute denotes individuals who earned a diploma from a two-year postsecondary technical institute.

a. On average, wages are 25 percent higher in public enterprises than in government for males and are 19 percent higher for females.

b. The wage equation estimates for private sector females have large standard errors due to a small sample.

c. White-collar vocational secondary graduates residing in Greater Cairo are the reference.

d. Individuals with fifteen years of experience and residing in Greater Cairo are the reference.

Source: Author's calculations.

reliance on seniority-based wage-setting rules in the public sector. At low levels of education, private sector wages are higher than public sector wages for males, but the gap nearly disappears at higher levels of education. An illiterate male with fifteen years of experience in the private sector earns nearly double what a similar worker would earn in the government, but starting at the secondary level there is near parity between the two sectors.

As shown in table 9, female wages are in general significantly lower in the private sector than in the public sector, and the gap increases with experience. Whereas female wages are in rough parity with male wages in the public sector,

there is a large gender-wage gap in the private sector even after correcting for observables and sample selection. Although it cannot be confirmed here, it seems that women face considerable discrimination in the Egyptian private sector. This discrimination is likely to be in the form of entry discrimination, whereby high barriers to entry into certain occupations result in overcrowding and, in turn, low pay in others.

To examine further the public-private wage differential, I use an extension of Oaxaca's (1973) decomposition of the wage differential that includes differences caused by selectivity bias (see also Idson and Feaster 1990; Terrell 1993). I decompose the total differential in mean wages between the government and the private sector, and between public enterprises and the private sector, into four components: (i) the difference in observed worker characteristics; (ii) the difference in the constant terms, which is sometimes interpreted as the premium or pure rent from being in a given sector; (iii) the difference in returns to worker characteristics in the two sectors; and (iv) the difference caused by selectivity.

$$\begin{aligned}\bar{y}_P - \bar{y}_R &= 0.5(\beta_P + \beta_R)(\bar{X}_P - \bar{X}_R) + (\beta_{0P} - \beta_{0R}) + 0.5(\bar{X}_P + \bar{X}_R)(\beta_P - \beta_R) \\ &\quad + [\rho_{1P}\sigma_P\bar{\lambda}_{1P} + \rho_{2P}\sigma_P\bar{\lambda}_{2P} - \rho_{1R}\sigma_R\bar{\lambda}_{1R} - \rho_{2R}\sigma_R\bar{\lambda}_{2R}].\end{aligned} \tag{8}$$

The components are evaluated at the sample means (indicated by bars over the variables). Recognizing that in the absence of differential wage-setting practices, the wage structure would lie between the two observed structures, I assign equal weights to the public and private sectors. (See Cotton 1988 for a discussion of this issue.)

The second and third components constitute the unexplained part of the mean wage differential. The decomposition is shown in table 10, which also shows the standard errors associated with each component. In all cases public sector workers have a positive and significant differential caused by differences in observed characteristics because they are generally more educated than private sector workers. The unexplained differential between government and private sector male workers is negative and statistically significant. It is caused primarily by a large difference in the intercept in favor of the private sector, which is partly counteracted by a higher return to human capital and other characteristics in the public sector. The unexplained differential between male workers in public enterprises and in the private sector is smaller and statistically insignificant. Given the queuing for public sector jobs, it is reasonable to assume that public sector workers receive some kind of rent. At least as far as males are concerned, this rent appears to be primarily in the form of nonwage benefits.

The situation for females is quite different. Because of the large gender-wage gap in the private sector and the more equitable wage-setting rules in the public sector, there is a large, positive unexplained differential in favor of both government and public enterprise workers. The differential appears to be primarily caused by higher returns to human capital in the public sector. Differences in the

Table 10. *Decomposition of Public-Private Wage Differentials, Egypt, 1988*

		Component				
Log wage comparison	*Total mean differential*	*Observed worker characteristics i*	*Constant term ii*	*Returns to worker characteristics iii*	*Total unexplained differential ii + iii*	*Selection iv*
Mean differential between government and private sector workers						
Males	0.058	0.306	−0.726	0.338	−0.387	0.139
		(0.058)	(0.179)	(0.149)	(0.142)	(0.127)
Females	0.382	0.234	0.276	0.514	0.790	−0.817
		(0.112)	(0.400)	(0.241)	(0.285)	(0.370)
Mean differential between public enterprise and private sector workers						
Males	0.208	0.264	−0.480	0.304	−0.177	0.120
		(0.040)	(0.180)	(0.140)	(0.136)	(0.127)
Females	0.523	0.299	0.457	0.446	0.903	−0.867
		(0.083)	(0.402)	(0.224)	(0.293)	(0.374)

Note: Calculations are based on the wage equations estimates (see table 8). See section IV and equation 8 in the text and Oaxaca (1973) for details of the decomposition procedure. Standard errors are in parentheses.

Source: Author's calculations.

constant terms are positive, but insignificant. The large negative selection differential captures the adverse selection of females into the public sector noted above.

To summarize, the wage equation estimates indicate that money wages are higher in the private sector than in the government for males, but the persistence of queuing suggests that the difference is not large enough to compensate private sector workers for differences in nonwage benefits. For females, government wages exceed wages in the private sector at all levels of education, and the gap increases with experience. Faced with a large gender-wage gap in the private sector and egalitarian wage setting in the public sector, educated females will clearly have a strong preference for the public sector.

Returns to Education

Using the wage equation estimates presented above, I compute private rates of return to schooling by sector and gender. Because of the large differences in benefits, job security, and work effort required in the public and private sectors, monetary compensation in the two sectors cannot be compared directly. A comparison of rates of return to schooling that does not disaggregate by sector would essentially compare lifetime income streams for educated workers, who are much more likely to be working in the public sector, with those of workers with less schooling, who are much more likely to be working in the private sector. The fact that public sector jobs have significantly higher nonpecuniary benefits reduces the overall rate of return to schooling. To get around this problem, I

calculate sector-specific rates of return to schooling by comparing lifetime streams of income for workers in the same sector at different levels of schooling. Subject to the assumption that the nonpecuniary benefits of a public sector job do not vary by level of schooling, this procedure overcomes the limitation of noncomparable compensation packages. However, because a given individual may be choosing between a job in the private sector at the lower level of education and one in the public sector at the higher level, keeping the comparison within one sector may not accurately reflect the choice set.

In computing rates of return to schooling, I assume that the direct costs of schooling are insignificant compared with the income forgone while in school and that the duration for which income is forgone is equal to the duration of the additional schooling. Although the first assumption is relatively unproblematic, the second may be a little problematic. Because graduates are much more likely to be unemployed at entry than nongraduates and, when unemployed, to have longer periods of unemployment, excess unemployment should be included in the calculation of the rate of return to schooling. The likely effect of such an adjustment would be to reduce the rate of return to secondary education and to increase the rate of return to university education because secondary school graduates face higher levels of unemployment than either university graduates or primary school graduates.

Private rates of return to schooling disaggregated by sector are shown in table 11. By international standards, rates of return to primary schooling are very low in Egypt. Psacharopoulos (1985) reports average private rates of return to primary schooling of 45 percent in Africa and 31 percent in Asia, compared with 2 to 4 percent for males and 4 to 8 percent for females in Egypt. Psacharopoulos (1983) also reports that rates of return tend to be lower in the noncompetitive public sector than in the competitive private sector because compression of pay scales in the public sector flattens mean earnings differentials and hence depresses the returns to education. I find the opposite to be true in Egypt up to the university level. The excess supply of vocational secondary school graduates seen in the high unemployment rates shows up again as very low or negative rates of return to that level of education.

Private returns to schooling are significantly higher on average at the university level than at the secondary or primary level and appear to be higher in the private sector than in the public sector, lending some credence to Psacharopoulos's wage-compression hypothesis. The gap between returns to schooling in the private and public sectors is largest for engineering graduates, who seem to be highly prized in the private sector.

Nonwage Benefits of Public Sector Employment

Given the importance of nonwage benefits in the public sector compensation package, it is worth attempting to quantify them. A search of the literature revealed very little work on this issue in the Egyptian context. Given the varied nature of these benefits, it is practically impossible to get a direct estimate of

Table 11. *Rate of Return to Schooling by Institutional Sector and Gender, Egypt, 1988*
(percent)

	Males		Females	
Level of education	*Public*	*Private*	*Public*	*Private*
Primary[a]	3.7	2.3	8.0	4.0
Secondary				
Vocational secondary, blue collar	8.2	2.1	1.3	1.2
Vocational secondary, white collar	6.9	Negative	5.1	Negative
General secondary	7.8	Negative	7.2	6.2
Tertiary				
Technical institute	8.4	4.8	5.3	Negative
Engineering baccalaureate	10.6	20.9	8.5	21.4
All other baccalaureate	8.2	8.8	8.6	20.6
Postgraduate[b]	11.6	14.6	11.2	11.7

Note: Calculations are based on the wage equation estimates (see table 8). Primary denotes individuals who earned a diploma after five years of primary school. Vocational secondary denotes individuals who completed a three-year vocational track. General secondary denotes individuals who earned a diploma from a three-year secondary school that leads to the higher education system. Technical institute denotes individuals who earned a diploma from a two-year postsecondary technical institute.

a. Assumes two years of labor income forgone compared with persons in the read and write category.

b. Uses the wage of "all other baccalaureate" to calculate opportunity cost.

Source: Author's calculations.

their value. The most obvious benefits include more complete social insurance and medical coverage and better job security, but other attractive aspects of public jobs may include fewer hours worked, less effort expended, access to bribes, opportunities for moonlighting, access to subsidized commodities and housing, and access to free transport. Although women are less likely to moonlight than men, they prefer public sector jobs because the lower level of effort and time required makes a public sector job more compatible with their domestic responsibilities. For example, in an interview quoted in the *Ahram* newspaper, a woman who resigned her job in a large private firm when faced with the possibility of losing her place in the queue for a government job said, "I want to rest. I have back pain as a result of the many hours of work I spend at the sewing machine at the factory. I want a position in the government so that I can rest" ("Escapees to the Public Sector," 1992). Another woman explained that a government job would enable her to work closer to home, thus allowing her to marry and start a family.

Elsewhere (Assaad 1996a), I obtained an estimate of the difference in nonwage benefits in favor of the public sector in Egypt by means of an indirect estimation strategy. I assumed that, on average, public sector workers receive some rent for being in the public sector, but that, at the margin, lifetime rent for some public sector workers is dissipated through queuing for public sector jobs. The marginal workers, whose lifetime rent is assumed to be fully dissipated, constitute the group of public sector workers (identified by a set of observable characteristics) who have the largest difference in monetary earnings over their lifetime in

favor of the private sector (that is, the lowest public sector rents). By equating the present values of total compensation across the public and private career paths, I estimated the ratio of nonwage benefits to wages. I then generalized the ratio to all workers on the assumption that nonwage benefits are proportional to wages. The results placed the value of nonwage benefits in the public sector at about 85 percent of wages, with a margin of error in the 10 to 20 percent range. Although still tentative, this estimate helps to explain why public sector jobs continue to be so attractive to graduates despite the long queues they must endure to get them.

IV. Conclusion

The employment guarantee for graduates and public sector compensation policies have indeed had a major effect on the Egyptian labor market. The employment guarantee has contributed to an unsustainable rate of growth in the government labor force, resulting in a bloated bureaucracy and severe overstaffing. By setting a floor for the wages and benefits that a graduate can achieve, compensation policies have encouraged queuing for government jobs, contributed to high graduate unemployment rates, and reduced graduate employment in the private sector. Despite de facto suspension of the program since 1990, the possibility of a government job continues to drive the labor market expectations of graduates. Because graduates can work part-time in the private sector while waiting for a government appointment, queuing is not excessively costly.

Rates of return to primary and secondary schooling in Egypt are well below those in comparable countries, especially in the private sector. Given these very low, sometimes negative, rates of return, why does anyone still invest in education? Clearly, education provides access to jobs with nonwage benefits that are not captured in the rate of return to education. The results of the sector selection equation confirm that education, and in particular secondary or higher education, is extremely important in obtaining a government job. Although access to such jobs for educated workers is in increasing jeopardy as the queues get longer, enrollment has not been sufficiently curtailed to reduce the excess supply of graduates.

Eligibility for the employment guarantee is achieved by reaching the secondary level of education. Because this threshold is most easily crossed by obtaining a vocational secondary degree, it is not surprising to find that the policy's greatest distortionary effect is observed for graduates at this level. They experience by far the highest unemployment rates and have the lowest rates of return to education in the private sector. Female vocational school graduates, who face much poorer prospects in the private labor market than their male counterparts, have an even greater incentive to queue for government jobs. With a public sector monetary wage nearly 200 percent higher than what they can expect to get in the private sector, not counting the supe-

rior nonwage benefits, queuing is a rational response despite the long waiting period.

Finally, because of wage compression in the public sector, the wage differential between the two sectors is less pronounced for university graduates. Wage compression, in effect, mitigates the effect of the public sector wage floor for this category of graduates.

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The Impact of Labor Market Regulations

Lyn Squire and Sethaput Suthiwart-Narueput

This article investigates the impact of labor market regulations in a setting with incomplete compliance. It takes as its starting point the limited evidence regarding the distortionary costs of labor market regulations and argues that there may exist natural limits to the efficiency losses engendered by such regulations. The article reviews some stylized facts regarding labor market behavior, presents an analytical model that may explain such behavior, and provides a checklist for assessing the distortionary impact of regulations such as minimum wages.

Does labor market regulation in developing countries result in significant efficiency losses? In his survey paper, Freeman (1993: 139) expressed surprise that "Studies designed to support the distortionist view of labor markets in developing countries failed to make a stronger empirical case than they did."

There are several possible explanations for this result. First, the regulations may not be binding at the market equilibrium. Second, even if the regulations are binding, the relevant elasticities of supply and demand may be so low that the impact of the regulations on efficiency is small. And third, even if the regulations are binding and the elasticities are sizable, compliance may be low. On this point, Freeman (1993: 128) notes that "If extensive unemployment results, the minimum will often be unenforceable because both workers and employers will have incentives to collude to avoid the law and save jobs." In this article we focus on the third reason and argue that the following proposition holds: *the likelihood of noncompliance will be greatest when the regulations are binding and the relevant elasticities are sizable.* That is, if the distortionary costs of regulations are not rendered insignificant by the first two reasons, then the returns to noncompliance will be high and, other things being equal, employers will either evade or avoid the regulations, thereby minimizing their impact on efficiency.

Lyn Squire and Sethaput Suthiwart-Narueput are with the Policy Research Department at the World Bank. This article was originally prepared as a background paper for *World Development Report 1995: Workers in an Integrating World.* The authors gratefully acknowledge Ahmed Galal, Dipak Mazumdar, Branko Milanovic, Martin Rama, participants at a *World Development Report* seminar at the World Bank, three anonymous referees for comments, and Marcel Fratzscher for research assistance. The authors also thank Martin Rama, Klaus Schmidt-Hebbel, Luis Servén, and various officials at labor departments in Ecuador, Egypt, Kenya, and the United States for their help in a small survey of labor enforcement practices.

The argument obviously depends on a comparison of the returns to noncompliance (increased profits) relative to its costs (penalties or transaction costs) and presumes some form of profit-maximizing behavior subject to tight budget constraints. This might be a fair approximation of the private sector reality of developing countries, but in many instances public sector enterprises have been an important form of industrial organization. It can be argued that such enterprises are not concerned exclusively with profit maximization and frequently face very soft budget constraints. This suggests that public enterprises may be more willing than private enterprises to conform with profit-reducing regulations. We argue that the very same factors that lead to this outcome may also imply that compliance does not have the efficiency costs that arise in the case of private producers. Therefore, we explore the proposition that, *although public enterprises are more likely to comply with labor market regulations, public enterprise compliance may actually reduce efficiency losses.* Taken together, the two propositions suggest that natural limits exist to the efficiency losses engendered by labor market regulations.

For concreteness of discussion, we focus on minimum-wage legislation. The approach, however, could be easily recast to deal with other forms of intervention (hiring and firing regulations, for example). We review some empirical evidence and stylized facts regarding labor market behavior and then provide an analytical model that may explain such behavior. The goal is to provide a framework and checklist for assessing the distortionary impact of labor market regulations such as minimum wages and for selecting case studies for future in-depth research. This approach is consistent with Freeman's (1993: 139) conclusion that "More can be learned from detailed case studies than from cross-country time-series regression with weak data."

Section I outlines recent trends in minimum wages throughout the developing world. Section II explores the proposition that noncompliance is greatest when the regulations are binding, and provides empirical evidence and stylized facts regarding noncompliance. Section III derives an analytical explanation for the behavior of firms in the private sector and establishes the conditions under which the distortionary impact is likely to be high. Section IV describes the situation in the public enterprise sector, which is modeled in section V. The final section presents a checklist for assessing the likely distortionary impact of minimum-wage legislation.

I. Recent Trends

The view that real minimum wages consistently rose in the 1970s and consistently fell in the 1980s is not fully borne out by the available data (see tables 1 and 2). The conventional view is most accurate in the case of Latin America. Although it is difficult to observe any trend in the 1970s, real minimum wages did fall throughout most of the region in the 1980s, in some cases by substantial amounts—by about half to one-third in most countries.

A similar picture might emerge for Africa if more data were available. As it is, the evidence for Africa reveals a mixed picture in both the 1970s and 1980s, and even where there are declines in the 1980s, the fall is much less than in Latin America—only about 20 percent. A relatively stable situation

Table 1. *Real Minimum Wages, Selected Countries, 1970–90*
(index, 1980 = 100)

Country	*1970*	*1975*	*1980*	*1985*	*1990*
Latin America					
Argentina	182	185	100	113	50
Bolivia	99	130	—	33	31
Brazil	90	94	100	84	51
Chile	64	61	100	63	88
Colombia	77	78	100	108	107
Costa Rica	88	77	100	112	121
Ecuador	49	51	100	61	44
Guatemala	118	96	100	85	61
Honduras	—	122	100	90	74
Mexico	91	91	100	67	42
Nicaragua	—	119	100	47	—
Panama	119	116	100	101	99
Paraguay	151	140	100	—	—
Peru	118	115	100	54	21
Uruguay	124	143	100	94	69
Venezuela	—	85	100	95	65
Asia					
Philippines	101	65	100	82	83
Sri Lanka	73	84	100	94	—
Thailand	—	84	100	117	117
Africa					
Algeria	56	69	100	—	—
Benin	—	143	100	91	—
Botswana	—	85	100	113	—
Burkina Faso	79	87	100	87	101
Congo	—	157	100	96	—
Côte d'Ivoire	104	114	100	84	—
Gabon	90	107	100	90	84
Ghana	415	509	100	144	114
Kenya	119	121	100	68	—
Malawi	—	119	100	120	—
Mauritius	—	—	100	104	—
Morocco	—	98	100	118	132
Niger	—	87	100	70	81
Senegal	99	111	100	78	78
Togo	143	131	100	80	80
Tunisia	—	77	100	110	100
Zaire	805	599	100	164	—

—Not available.
Source: Anker, Butare, and Marinakis (1992).

Table 2. *Percentage Change in Real Average and Minimum Wages, Selected Countries, 1980s*

Country	Average wage (1)	Minimum wage (2)	Difference (1) – (2)
Latin America (1980–87)			
Argentina	–0.5	20.8	–21.3
Brazil	2.3	–35.3	37.6
Chile	–6.0	–42.4	36.4
Colombia	19.3	13.0	6.3
Costa Rica	–7.7	18.1	–25.8
Guatemala	–22.7	–38.9	16.2
Honduras	–8.0	–16.0	8.0
Mexico	–43.3	–43.2	8.4
Paraguay	–1.9	20.0	–21.9
Peru	–10.8	–39.2	28.4
Uruguay	14.0	10.9	3.1
Africa (1980–86)			
Burundi	4.7	–3.5	10.7
Kenya	40.6	54.6	–14.0
Malawi	3.7	–24.0	27.7
Mauritius	–22.8	–41.2	18.4
Asia (1980–88)			
Sri Lanka	–11.4	–6.2	–5.2
Thailand	86.4	12.2	74.2

Source: ILO (1990).

emerges for the three Asian countries: movements up and down stay within 20 percent of the 1980 base.

II. The Private Sector and Enforcement strategy

The impact of minimum-wage legislation is limited because of incomplete compliance by private firms. For the purposes of this article, we treat noncompliance as payment below the minimum wage. As discussed later, it can take two forms: outright evasion or (legal) avoidance, for example through the use of temporary contracts. Impact is defined as a change in the demand for labor. An increase in a perfectly enforced and binding minimum wage would lead unambiguously to a fall in the demand for labor. This textbook proposition has come under question in the U.S. context (see Card and Krueger 1995). With incomplete compliance, the demand for labor could fall, remain constant, or even increase. This section identifies the circumstances in which these different outcomes will hold.

Noncompliance in the Private Sector

Noncompliance occurs in a variety of countries and is significant even among industrial countries with the proper apparatus—established bookkeeping and

reporting procedures, for example—for regulatory enforcement. Analyzing 1973 data for the United States, Ashenfelter and Smith (1979) find that only 64 percent of the persons who would have earned less than the minimum in the absence of legislation were paid in compliance with it. For California in 1989, Card (1991) finds that noncompliance was as high as 46 percent among workers directly affected by the increase in the minimum wage. Noncompliance in the entire population, however, was less than 2 percent.

Turning to developing countries, household survey data for Mexico reveal that, in 1988, 16 percent of all full-time male workers in the informal sector and as many as 66 percent of female workers in various sectors were paid below the minimum wage (Bell 1994). These percentages are significant given the large size of the informal sector: only 18.2 percent of all enterprises in 1988 were estimated to have been fully meeting all legal requirements regarding inscription and contributions (Standing and Tokman 1991). In Colombia in 1983, 4.7 percent of even large manufacturing enterprises did not comply with the minimum-wage legislation (Bell 1994). In Morocco more than 50 percent of the firms paid their unskilled workers less than the minimum wage in 1986 (Harrison 1993). In Sub-Saharan Africa the extent of noncompliance is even more striking. A recent survey of 300 informal sector firms in Niger revealed that 293 did not comply with minimum-wage regulations; in Swaziland, 242 out of 290 failed to comply (Morrisson 1993).

The pattern of noncompliance. Because the observed extent of noncompliance represents a joint response to both the costs of compliance and the costs of enforcement, it is difficult to disentangle the two. In certain instances, however, it may be possible to identify the two effects separately through careful interpretation of time-series and cross-sectional data coupled with some assumptions.

Several cases indicate that noncompliance increases with the costs of compliance for the firm. In California noncompliance affected 31 percent of the persons directly affected by the minimum-wage legislation in 1987 and 46 percent in 1989, when the minimum wage increased from $3.35 to $4.25 per hour (Card 1991). Because the intensity of enforcement is not likely to have changed significantly in such a short period of time and median wages rose only 7.6 percent, much of the increase in noncompliance was likely caused by the increased costs of complying with the higher minimum wage.

In Puerto Rico, noncompliance (in the entire population of workers) rose from around 20 percent in 1979 to 35 percent in 1983, when the minimum wage increased from $2.56 to $3.35. Noncompliance in Puerto Rico is likely to have been significantly higher, because only 64 percent of the workers were covered by the minimum-wage legislation and the workers not covered were probably employed in the informal sector and small enterprises (see Freeman and Freeman 1991). Again, assuming that the intensity of enforcement remained more or less the same, this suggests that noncompliance increased because the costs of compliance to the firm increased.

Conversely, noncompliance in Mexico decreased along with the costs of noncompliance when real minimum wages decreased during the 1980s. The ratio of the minimum to average wage for blue-collar workers fell from 0.42 to 0.34 from 1984 to 1989, while the percentage of large manufacturing firms paying average wages below the minimum similarly fell from 3.0 to 1.9 percent (Bell 1994). If the structure of enforcement did not change markedly, this would indicate that noncompliance fell along with the decrease in the costs of complying with minimum-wage regulations.

Given the increase in the number of firms over time, we would expect compliance to fall unless the enforcement budget is increased commensurately. In general, cross-country comparisons are problematic because the structure of enforcement could differ significantly across countries. However, because the enforcement systems in both California and Puerto Rico are under the U.S. Department of Labor and are therefore likely to be similar, the significantly higher ratio of noncompliance in Puerto Rico could be attributed largely to the relative costs of compliance: the ratio of minimum to average earnings was 63 percent in Puerto Rico but only 34 percent in the United States as a whole in 1987.

The pattern of noncompliance is also consistent with the observation that noncompliance varies with the ease of enforcement. Although it is unclear how enforcement costs vary over time, there are sound reasons for believing that they vary across the population of firms and workers at a given point in time. For example, because enforcement costs (on both a per firm as well as a per worker basis) are likely to be higher for small firms operating in the informal sector, it is not surprising that noncompliance is also significantly higher in this group. The percentage of full-time male workers with wages below the minimum was more than 16 percent in the informal sector, but less than 3 percent in the formal sector in Mexico (Bell 1994). In Morocco, wage histograms show that noncompliance in enterprises with fewer than twenty employees is significantly higher than in larger enterprises (Harrison 1993).

Of course, this pattern is also consistent with higher compliance costs for the firm. Smaller, informal sector firms typically hire more unskilled than skilled labor, more younger than older workers, and more women than men relative to larger firms in the formal sector. To the extent that labor markets are segmented, these smaller, informal sector firms could face higher efficiency losses from compliance because the average wage for these demographic groups is lower and their elasticity of labor demand is higher. It is therefore not surprising that compliance is noticeably lower for these demographic groups. In California in 1987, 67 percent of persons who earned less than the minimum wage were twenty-four years of age or younger, 37 percent were Hispanics, and 67 percent were female (Card 1991). In Mexico, despite a decline in real minimum wages, noncompliance remained significantly high in the informal sector, in the south, for women, and for people with little or no education. Regarding region, noncompliance in the south of

Mexico was 29 percent for full-time workers in the informal sector but only 8.2 percent for the same group in Mexico City. Regarding education, noncompliance for full-time male workers in the informal sector with no education was 26.5 percent but only 2 percent for those in the same sector with sixteen or more years of education (Bell 1994). Wage histograms for Morocco also show that noncompliance is significantly higher for unskilled female workers than for men (Harrison 1993).

Although cross-country comparisons do not allow the effects of compliance and enforcement costs to be distinguished, they can nonetheless be revealing. Differences in noncompliance between countries in Sub-Saharan Africa and other countries are very striking. In contrast to the noncompliance figures for Niger and Swaziland cited above, only 49 out of 503 firms in Thailand, and 29 out of 269 in Ecuador, were in noncompliance with minimum-wage regulations (Morrisson 1993). Minimum wages have considerably less bite in Mexico than in Colombia, which indicates that the incentives for noncompliance are much higher in the latter. Annual industrial surveys for manufacturing firms in both countries show that in Mexico only 10 percent of the firms paid average blue-collar wages less than 1.5 times the minimum wage compared with 29 percent of Colombian firms in 1986 (Bell 1994).

Legal noncompliance. Widespread noncompliance is not surprising in view of the numerous means for legally avoiding such regulations. Many countries exempt teenagers, apprentices, workers in training, and part-time workers from the minimum-wage legislation. In Morocco, for instance, firms are allowed to pay as little as 50 and 80 percent of the minimum wage for fourteen- to fifteen-year-olds and seventeen- to eighteen-year-olds, respectively; this regulation provides significant incentives for legal avoidance. The renewal of temporary contracts is a common means of avoiding payment of the minimum wage in Mexico. This form of avoidance is particularly widespread in large-scale industries and among such government-controlled enterprises as the petroleum monopoly, probably because outright evasion is more difficult and riskier in these sectors and for these enterprises (see Standing and Tokman 1991).

The survey of informal sector firms conducted by Morrisson (1993) shows that even when firms formally comply with minimum-wage regulations de jure, they may avoid them de facto by hiring "false apprentices" or failing to pay overtime. In Algeria, Jamaica, and Thailand, compliance with the minimum-wage legislation was significantly higher than compliance with regulations regarding the payment of overtime. In Jamaica, while 58 percent of firms complied with minimum wages, only 21 percent complied with the payment of overtime. Similarly, in Algeria and Thailand, 54 and 77 percent, respectively, complied with minimum wages but only 46 and 64 percent, respectively, complied with the payment of overtime. (These percentages are only of firms that responded to Morrisson's survey.)

Enforcement Strategy

The patterns of compliance described represent outcomes that reflect both the behavior of private firms and the regulator's strategy of enforcement. The analysis of Ashenfelter and Smith (1979) illustrates this point well. Their analytical model predicts that firms employing low-wage workers and for which wage changes produce large employment adjustments have the greatest incentives to violate the law. But they argue that this incentive is more than fully offset by the higher probability of government detection that results from the government's enforcement strategy.

Although theoretical models of enforcement with formally specified regulator behavior do exist (for example, Garvie and Keeler 1993; Polinsky and Shavell 1990), they may be based on a view of regulator behavior that has little to do with actual enforcement practice. The literature on this is unfortunately rather sparse. However, it appears not only that actual regulator strategies may diverge from those predicted on the basis of statutory directives but also that the ability of regulators to execute their strategies could be quite limited.

Of particular interest are the studies on the enforcement of affirmative action regulation among federal contractors by the U.S. Office of Federal Contract Compliance Program (OFCCP). Under Executive Order 11246, federal contractors agree "to take affirmative action to ensure that applicants are employed and employees are treated during employment without regard to their race, color, religion, sex, or national origin" (cited in Leonard 1990: 48). Given this mandate, it would be reasonable to expect the OFCCP to concentrate its compliance reviews on establishments with a relatively small proportion of females and black males. However, Heckman and Wolpin (1976: 547) examine the incidence of compliance reviews among 1,185 Chicago-area establishments and discover "no evidence of a systematic government policy for reviewing contractor firms." The probability of review was not affected by the size of the establishment or by the level of or change in minority employment.

In a later study of compliance reviews of 7,369 defense contractor establishments for 1975–79, Leonard (1985: 378) finds that "the *greater* the proportion of female or minority male, the *more* likely is a review" (italics added). On paper, the OFCCP does have formal targeting systems that select establishments with a low relative proportion of minorities or females for review. However, as Leonard notes (1985: 374),

> In practice, targeting at the OFCCP has for the most part been done on an ad hoc decentralized basis, with field officers exercising considerable discretion. Field officers tend to be evaluated on fulfilling goals for compliance reviews, rather than on successfully bringing discriminators to heel. . . . The fastest way to fill a production goal for compliance reviews is to review firms with good records and good behavior.

Not only is the strategy of the regulator far from obvious, but its ability to execute its strategy effectively is also unclear. Preliminary results from our small,

informal survey of the departments of labor in several countries indicate that the actual impact of enforcement activities is severely circumscribed by inadequate staff resources, limited budgets, and small penalties.

Limited inspection resources. Even in the case of the U.S. Department of Labor, only 800 federal wage-and-hour inspectors nationwide cover about 2.6 million employers. In Ecuador the Inspección del Trabajo has only twenty-six inspectors in the Quito office, which covers about half of the country's labor force. In Bangladesh the 1991 annual report of the Ministry of Labor and Manpower Inspectorate mentions only two investigations under the Minimum Wages Act (World Bank 1994).

Where inspection resources are limited, investigations tend to be initiated in response to complaints rather than to be random.[1] In the United States nearly three-quarters of the compliance actions taken in 1992 and 1993 were driven by complaints. In Ecuador inspections are typically only carried out when requested by workers or, more often, by unions. In Morocco unions are similarly a major channel for transmitting complaints regarding violations of labor regulations. By contrast, in Egypt, which has 1,600 inspectors and more plentiful inspection resources, random inspections are the norm, and those driven by complaints are few.

Small explicit penalties and weak enforcement. Statutory penalties are quite low. In the United States most minimum-wage violations involve only paying back the difference in wages owed to the workers. In 1989 Congress instituted a civil monetary penalty for repeated or willful (that is, falsified records with an intent to conceal) minimum-wage and overtime violations. Employees can also bring cases of violations of the Fair Labor Standards Act directly to court without any involvement by the U.S. Department of Labor, in which case they may get double the amount of losses plus court fees. Labor law violations in Kenya typically lead to advice of correction rather than penalties. The Kenya Department of Labor typically employs the following procedure when detecting noncompliance: provide advice of correction for a maximum of one to three times for a period of two to four weeks and take the firm to court if the violation is not corrected. Penalties require court sentences and are in any case quite low: current maximum fines are capped at $75 per offense (not per worker).

Enforcement of penalties is even more limited. In Bangladesh, although 411 violations were detected in 1988, 518 in 1989, and 610 in 1990, there were only 13 prosecutions in 1990 and 3 in 1991 (World Bank 1994). In Kenya only 60 court convictions (and 212 prosecutions) resulted from the 26,625 inspections

1. There is also the danger of engaging in mostly surface enforcement (that is, conducting more desk reviews and fewer in-depth audits). After 1980 the OFCCP doubled the number of compliance reviews despite reductions in staffing and the real budget. Not surprisingly, "Fewer administrative complaints were filed, back-pay awards were phased out, and the already rare penalty of debarment became an endangered species" (Leonard 1990: 58).

carried out by the Department of Labor in 1993. In Ecuador, in spite of a "rush" by firms to regularize their arrears following a reform of the Labor Code in 1991, the total amount of fines collected in fiscal 1993–94 was only around $5,000. In many cases, there is little direct financial incentive to collect penalties. In Kenya fines collected are transferred back to the Treasury. In Egypt, although funds go back to the Ministry of Manpower and Employment, the collection of penalties levied is the responsibility of the Ministry of Justice and the Ministry of the Interior.

III. The Model for the Private Sector

The analysis presented in this section captures the interaction between firms and the regulator by assuming that firms face a known probability of inspection. This approach is followed for two reasons. First, there is no empirically established view regarding the regulator's objective function. Second, alternative objective functions—such as minimizing evasion or maximizing net financial returns from inspection—lead to little change in the analysis other than the replacement of a known probability of inspection with the distribution of enforcement costs by type of firm. In the following, we present a simple model in which the probability of inspection increases with firm size.[2]

Some firms may fail to pay the minimum wage by legal avoidance, and others may engage in outright evasion. Firms following the former route—for example, by subcontracting or hiring only temporary or young workers to whom the legislation does not apply—can be expected to incur various training or transaction costs that have to be incorporated in any assessment of the welfare effects of the legislation. In our setup, switching to temporary workers to avoid paying the minimum wage is different than switching from labor to capital because of minimum-wage regulations. Switching from permanent to temporary workers involves paying below the minimum wage (what we have termed "avoidance"), while switching from labor to capital involves paying the (higher) minimum wage (what we term "compliance"). Firms following the outright evasion route may not incur real resource costs but will of course face possible punitive action if they are investigated. The model allows for both possibilities.

Firm Options

Assume a size distribution of profit-maximizing firms differentiated by a productivity parameter θ_i. The model treats a single-production technology. This has two important implications. First, it does not capture the possibility that labor market legislation influences the choice of technology. Although potentially important, it is not obvious that labor market legislation is by

2. We also ran a version of the model in which the probability of inspection is constant with respect to firm size. It yielded a different pattern of firm compliance, but the main qualitative results of the analysis carried through.

itself likely to be a main determinant of technology. And second, with a single-production technology, differences in firm size stem only from differences in productivity. In reality, of course, firms differ in size because of differences in technology as well as in productivity (that is, unproductive firms making petrochemicals tend to be larger than productive ones making garments).

With these comments as background, assume that θ_i has a cumulative distribution $G(\theta)$ with support $(\underline{\theta}, \overline{\theta})$. The government introduces a minimum wage into this setting. Firms have three options. First, pay the minimum. Second, legally avoid the minimum through various costly actions such as subcontracting or hiring part-time workers. And third, evade. The formulation for the payoff under evasion reflects beginning-of-period inspection and the fact that the model deals with an instant in time. During that instant, a *potential* evader either evades for the entire instant or is caught on suspicion, as it were, and both complies and pays the penalty for the entire instant. The expected payoffs $E\pi_i$ for each option are:

$$E\pi_i = \begin{cases} \pi(\theta_i, \overline{w}); \text{ if comply} \\ (1-\beta)\pi(\theta_i, w) + \beta\{\pi(\theta_i, \overline{w}) - \Gamma\}; \text{ if evade} \\ \pi(\theta_i, w) - A; \text{ if avoid} \end{cases} \tag{1}$$

where

$$\pi(\theta_i, w) = \max_{K,L} p\theta_i F(K,L) - wL - rK \tag{2}$$

and w is the market wage, $\overline{w}$ is the minimum wage, β is the probability of inspection, Γ is the penalty, and A is the fixed cost associated with avoidance.[3] $F(K, L)$ is homogeneous of degree less than 1 in its arguments because of the presence of some fixed factor. We assume throughout that $\overline{w} > w$ and define units in such a way that w and $\overline{w}$ incorporate nonwage benefits as well. As mentioned above, we assume the probability of inspection to be higher for larger firms and let β be strictly increasing in θ_i. Although θ_i itself is directly unobservable, in this simplified setting there is a one-to-one correspondence between firm size and θ_i. We can therefore represent an inspection policy that targets larger firms as a function β that is increasing in θ_i.

3. There are several implications in allowing the penalty, Γ, and cost of legal avoidance, A, to be functions of employment. Consider, for example, $A(L) = aL$ and $\Gamma(L) = \gamma L$. In this case, there is a knife-edge situation depending on parameter values. If $\overline{w} - w > a$, then firms prefer to avoid rather than comply, but if $\overline{w} - w < a$, then firms prefer to comply rather than avoid. Because this holds for any given value of θ_i, we only observe evading and complying *or* avoiding firms, but not all three. In the case of $\Gamma(L)$, the penalty could be imposed on the number of workers employed when the firm evades. Labor demand under evasion becomes $L(\theta_i, w + \beta\gamma)$. Inequality 3, which indicates when firms prefer to evade rather than comply, becomes $\pi(\theta_i, w + \beta\gamma) - \pi(\theta_i, \overline{w}) > \beta\gamma L(\theta_i, w + \beta\gamma) / (1 - \beta)$. If $w + \beta\gamma = \overline{w}$, then $\beta\gamma L(\theta_i, \overline{w}) > \pi(\theta_i, w + \beta\gamma) - \pi(\theta_i, \overline{w}) = 0$, and firms prefer to comply rather than evade. Because this is true for any θ_i, if $\gamma > [(\overline{w} - w) / \beta]$, we would never observe any evading firms.

From equation 1, firms will evade rather than comply if

$$\Delta\pi \equiv \pi(\theta_i, w) - \pi(\theta_i, \overline{w}) > \frac{\beta(\theta_i)\Gamma}{1-\beta(\theta_i)}. \tag{3}$$

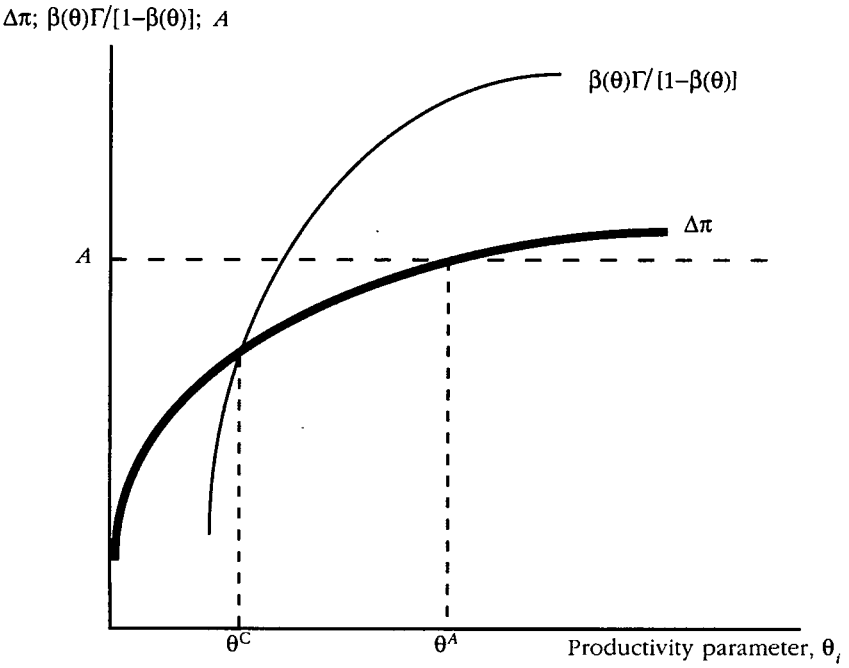
Firms will comply rather than avoid if

$$\pi(\theta_i, w) - \pi(\theta_i, \overline{w}) < A. \tag{4}$$

We know from equation 2 and the envelope theorem that the derivative of the left side of the above inequalities with respect to θ_i is positive for $\overline{w} > w$. This is not altogether surprising because higher θ firms will be larger and will obtain greater surplus from hiring at a lower wage than will smaller firms. We consider the situation when β increases in θ_i sufficiently sharply that the right side of inequality 3 intersects the left side from below as depicted in figure 1. We also separately considered the case when the right side of inequality 3 intersects the left side from above; for example, when $\beta(\theta_i) = \beta$. This yields a different pattern of firm compliance in which lower θ_i firms comply, intermediate θ_i firms evade, and larger θ_i firms avoid. The main qualitative results, however, carry through whether the intersection is from above or below.

We denote the values of θ_i that satisfy inequalities 3 and 4 with equality as θ^C and θ^A, respectively. Given the direction of inequalities 3 and 4, it follows

Figure 1. *Pattern of Firm Compliance*



that we only observe firms (an interval of θ_i) seeking to comply if $\theta^C < \theta^A$ or

$$A > \frac{\beta(\theta^C)\Gamma}{1-\beta(\theta^C)}. \tag{5}$$

If the transaction cost of avoidance A is not sufficiently large, there will be no compliance, because firms either evade or avoid. Firms will evade if $\Delta\pi(\theta_i) < A / [\beta(\theta_i) - \Gamma]$; and they will avoid otherwise. For the remainder of the article, we assume that inequality 5 holds because it is the more interesting case.

We now consider the pattern of compliance. For those firms with $\theta_i < \theta^C$, $A > \Delta\pi(\theta_i) > \beta(\theta_i)\Gamma / [1 - \beta(\theta_i)]$. The first inequality implies that these firms prefer to comply rather than to avoid, while the second implies that they prefer to evade rather than to comply. Firms in this range therefore evade. For those firms with $\theta_i \in (\theta^C, \theta^A)$, $A > \Delta\pi(\theta_i)$ still, but $\beta(\theta_i)\Gamma / [1 - \beta(\theta_i)] > \Delta\pi(\theta_i)$. The first inequality again implies that firms prefer to comply rather than to avoid, but the second now implies that they prefer to comply rather than to evade. Firms in this second range therefore comply. Lastly, for firms with $\theta_i > \theta^A$, $\beta(\theta_i)\Gamma / [1 - \beta(\theta_i)] > \Delta\pi(\theta_i)$ still, but $\Delta\pi(\theta_i) > A$. The first inequality implies that firms prefer to comply rather than to evade, while the second now implies that they prefer to avoid rather than to comply. Firms in this last range avoid. We therefore get the result that smaller, less productive firms with $\theta_i \leq \theta^C$ *evade*, those with $\theta^C < \theta_i \leq \theta^A$ *comply*, and larger, more productive firms with $\theta_i > \theta^A$ *avoid*.

Regulator Options

Inequality 3 shows that the regulator can influence the degree of evasion through two variables: the probability of inspection and the severity of the penalty. Other things being equal, the regulator can minimize noncompliance by increasing these two variables. The effective penalty may reflect not just explicit statutory penalties (which as indicated above may be quite minimal) but also any reputation or other cost associated with being found in violation of labor regulations. The regulator can also influence the extent of avoidance through the precision and comprehensiveness of the relevant labor legislation that would work through the fixed transaction cost, A (see inequality 4). As loopholes in the legislation are progressively closed, the transaction costs associated with avoidance are likely to increase.

Taking stock of these results, we conclude the following. First, increases in the *probability of inspection* β lower θ^C. The proportion of firms complying increases, while the proportion of those evading decreases. Second, increases in the per firm penalty, Γ, have a similar effect. Third, increases in *the specificity of the labor legislation* raise θ^A. The proportion of firms avoiding decreases, and the proportion of firms complying increases.

Although the regulator has sufficient instruments to eliminate evasion and avoidance, the empirical evidence makes clear that regulators choose not to do this. The regulator's choice reflects both the objectives of the regulator and the costs of enforcement. Depending on the objectives, the real costs associated with avoidance may also influence the regulator's view of the relative merits of evasion and avoidance.

Labor Market Outcomes

Does the likelihood of noncompliance increase as the (binding) minimum-wage increases and as the elasticity of labor demand increases? First, we establish that this is indeed so. Second, we derive the circumstances in which an increase in a binding minimum wage results in increased demand for labor. And third, we discuss the implications of these results for the efficiency losses arising from labor market regulation.

Consider the left side of inequality 3, denoted $\Delta\pi$, in figure 1. An increase in $\overline{w}$ shifts up $\Delta\pi$ and therefore increases θ^C. To determine the impact of changes in elasticity, we conduct a second-order Taylor series expansion on $\Delta\pi$ around (w, θ^C). With some manipulation, this yields

$$L(w,\theta^C)(w-w) - \frac{1}{2}\frac{L(w,\theta^C)}{w}(w-w)^2 e \tag{6}$$

where $e < 0$ is labor elasticity. Because expression 6 increases with the absolute value of e, an increase in the absolute value of e shifts up $\Delta\pi$ and increases θ^C while decreasing θ^A, which decreases the proportion of complying firms. Thus, the likelihood of noncompliance does increase with both the minimum wage and the elasticity of demand for labor, which makes intuitive sense. Both of these factors increase the costs of the minimum wage and therefore encourage more noncompliance.

We now examine the effect of an increase in the minimum wage on labor demand. We conduct a partial equilibrium analysis and take the market wage as given. This could occur, for example, in a small formal sector in which the wage level is determined outside the market, although in a more general setting, changes in the level of the minimum wage could affect the market wage, w. Total labor demand $L^D(.)$ is given by

$$L^D(.) \equiv -\int_{\underline{\theta}}^{\theta^C} \pi_w(\theta_i, w)\mathrm{d}G(\theta)\mathrm{d}\theta - \int_{\theta^C}^{\theta^A} \pi_w(\theta_i, \overline{w})\mathrm{d}G(\theta)\mathrm{d}\theta - \int_{\theta^A}^{\overline{\theta}} \pi_w(\theta_i, w)\mathrm{d}G(\theta)\mathrm{d}\theta \tag{7}$$

where the three integrals correspond to labor demand from evading, complying, and avoiding firms, respectively. After some manipulation and simplification, the effect on labor demand of increasing $\overline{w}$ is given by

$$\theta^C_{\overline{w}}[L(\theta^C, w) - L(\theta^C, \overline{w})] - \theta^A_{\overline{w}}[L(\theta^A, w) - L(\theta^A, \overline{w})] + \int_{\theta^C}^{\theta^A} \frac{\partial L(\theta_i, \overline{w})}{\partial \overline{w}}\mathrm{d}G\mathrm{d}\theta \tag{8}$$

where $\theta^I_{\overline{w}}$ is the partial of θ^I with respect to $\overline{w}$.

The result fits with intuition. Recall that θ^C increases (and θ^A decreases) with $\overline{w}$ and that $L(\theta^j, w) - L(\theta^j, \overline{w})$ is positive for $\overline{w} > w$. Each of the first two products in expression 8 is therefore positive and represents the increase in the proportion of noncomplying firms $(\theta^j_{\overline{w}})$ multiplied by the increase in labor demand as (each) firm switchs from compliance to noncompliance. The integral is negative and captures the decrease in labor demand from complying firms—those in the interval (θ^C, θ^A)—caused by higher minimum wages. Because the integral term is a second-order effect compared to the two product terms, expression 8 could well be positive, and an increase in the minimum wage could increase labor demand as a result of lower compliance. However, this depends on the size of the gap between the minimum and market wages. The expression is more likely to be positive the greater the gap between minimum and market wages, because $L(\theta^j, w) - L(\theta^j, \overline{w})$ is larger and the proportion of complying firms is smaller. If the minimum wage is close to the market wage, however, then the proportion of complying firms is large, and the expression is likely to be negative because the effect of decreased labor demand on compliers will dominate. We therefore have a Laffer-curve type of relationship between the minimum wage and labor demand caused by incomplete compliance. This relationship contrasts markedly with the outcome in a world of complete compliance, where raising the minimum wage unambiguously lowers labor demand and increases unemployment.

What are the implications of these results for the efficiency losses usually associated with labor regulations? There are at least three effects of an increase in minimum wages, assuming that enforcement costs remain fixed: an increase in the distortion for complying firms, a reduction in the costs of distortions as firms switch from being compliers to being noncompliers, and an increase in transaction costs as firms switch from being evaders to being avoiders. The first two effects arise immediately from expression 8, and the third derives from expression 4 defined with equality. As with labor demand, these results imply that efficiency losses could increase, stay constant, or fall as the minimum wage is increased. Moreover, the likelihood of a reduction in efficiency losses will increase with the size of the existing distortion, which, as we have seen, is one of the factors determining the likelihood of an increase in labor demand. This analysis points, therefore, to the existence of natural limits on the magnitude of efficiency losses.

These results have two implications for policy. First, although the efficiency losses from compliance may arguably be justified on redistributive grounds because compliance results in a transfer to workers, governments are unlikely to be willing to incur the costs (enforcement costs and efficiency losses) associated with full compliance. (Compliance does not necessarily lead to a more equitable outcome; although rent is transferred to employed workers, the number of employed workers is reduced.) There is therefore likely to be an optimal degree of noncompliance. Second, because there is no redistributive transfer to workers under avoidance relative to evasion, and yet there are real resource costs associ-

ated with the former, it may be preferable to reduce legal avoidance rather than evasion. Another factor is that the avoiding firms are larger than the evading ones in our setup and will therefore incur higher distortionary costs from compliance. Tightening legislation will also make it costlier for those that continue to avoid. The policy response should be to focus on tightening legislation in an effort to cut back on legal avoidance rather than to increase inspections and penalties per se. This result holds even if real costs are associated with evasion, as long as those costs are less than those incurred when avoiding.

The results also bear on the recent debate in the literature regarding the impact of minimum-wage legislation on employment in the United States. Card and Krueger (1995) summarize an array of statistical evidence and conclude that increases in the minimum wage have not reduced employment and may *even have increased it.* Their empirical evidence is hotly disputed. We are not in a position to judge the empirical validity of their conclusion. We note, however, that our results and, in particular, the change in compliance following an increase in the minimum wage could explain what they claim to observe. Moreover, our explanation does not require invoking the untested assumption of monopsony power or informational imperfections; rather it rests on a standard competitive model with incomplete compliance. Although our model may have more relevance for developing countries where enforcement is especially weak, in some of the "natural experiments" considered by Card and Krueger, noncompliance did increase as predicted by our model.

IV. Public Enterprises

In this section we examine the impact of labor market regulations on public enterprises. We assume that public enterprises operate according to a different objective function and effectively face a looser budget constraint than private enterprises.

Large and Growing Employment and Wage Bills

Public enterprise employment and wage bills have often grown very rapidly in developing countries and have remained large. After a strong increase in public enterprise employment during the 1960s and 1970s, the share of public enterprise employment in total employment remained relatively constant at between 5 and 6 percent worldwide between 1978 and 1991 (see table 3). But regional differences in public enterprise employment remain large. Between 1986 and 1991 the share of public enterprises in total employment in Africa was 18.1 percent, significantly larger than the corresponding share in Latin America (3.7 percent) and Asia (4.7 percent). This share was as high as 46.4 percent in Niger, 45.3 percent in Senegal, and 37.2 percent in Zambia (Galal 1994).

Even in those countries where real wages in the public sector have declined, these reductions have often been more than offset by an increase in public sector employment. In her study on public sector pay and employment policies, Nunberg

Table 3. *Weighted Average Share of Public Enterprises in Employment, Selected Countries, 1978–91*
(percent)

Region	*1978–85*	*1986–91*	*1978–91*
Africa	17.55	18.07	17.77
Asia	4.92	4.68	4.82
Latin America and the Caribbean	4.07	3.67	3.90
World	5.55	5.28	5.43

Note: Only a subset of countries within each region was used for deriving world averages. The Latin American and Caribbean regional average excludes Argentina, Brazil, Ecuador, Grenada, and Trinidad and Tobago. The African regional average excludes Burundi, Côte d'Ivoire, Egypt, Kenya, Malawi, Niger, Senegal, Seychelles, and Tanzania. The Asian regional average excludes Indonesia, Myanmar, Sri Lanka, and Vietnam. Three-year moving average estimates were used to complete our time series in case of missing values when deriving regional averages. Regional weighted averages were obtained using GDP in current U.S. dollars as weights.
Source: Galal (1994).

(1988) found an excessive wage bill to be a major problem for the majority of countries where the World Bank pursues government pay and employment interventions. In Egypt, for example, the wage bill grew from 22 percent of government expenditures in the mid-1970s to 33 percent in the late 1980s (Banerji and Sabot 1993).

Noneconomic Objectives

Public enterprises are often assigned employment goals, are required to act as model employers, and may be required to serve as employers of last resort. Although governments seek to protect real wages for workers, when this is not possible they may attempt to protect employment by cutting spending on nonwage items, compressing the wage structure, and cutting real wages.

Public enterprises act as model employers and seek to protect workers against declines in the wage rate. In Morocco overall productivity in formal manufacturing fell between 1985 and 1990. However, although the productivity decline was larger in the public sector, real wages in the public sector rose 0.4 percent a year, while falling 2.3 percent in the private sector, even though they were higher than real wages in the private sector to begin with (Harrison 1993). In Bangladesh five out of seven public enterprises sampled had increases in average labor costs that outpaced increases in productivity. For a public enterprise producing steel billets and plates, average labor costs increased 55 percent between 1985 and 1992, but the value of output per worker actually fell 18.6 percent (World Bank 1994).

When operating under tight financial constraints, however, governments may seek to protect employment by reducing spending on material. The ratio of wage to nonwage public expenditures has been increasing in many countries with fiscal constraints, which indicates growing distortions and imbalances in the input mix of public sector production. In Liberia, for example, the wage bill in relation to revenues increased from 36 percent in 1977 to 66 percent in 1981 (Lindauer 1988).

The government may also compress the wage structure to protect employment of lower paid workers, often reducing wages for their more skilled employees below those offered for equivalent skills in the private sector. Lindauer, Meesook, and Suebsaeng (1987) find significant salary compression for a number of African countries. In Ethiopia, for example, the lowest real salaries in the public sector fell 37 percent between 1975 and 1985, but real wages fell nearly 70 percent for the highest salaries (ILO 1990). In Zambia the salary ratio between the highest- and lowest-rank civil service employee fell from 19.2 percent in 1970 to 6.9 percent in 1983 (see Lindauer 1988). As a consequence, the wage difference for skilled labor between the private and public sector has become particularly high. In Thailand in 1982 the differential for top positions in both sectors was as high as 350 percent (Lindauer 1988).

Because there is a negative tradeoff between employment and the wage bill when governments are financially constrained, governments may resort to reducing real wages to protect employment. There has been a considerable reduction in real wages in Africa. Public sector wages for the lowest salary groups fell 45 percent between 1975 and 1985, whereas the highest salaries in the public sector fell more than 60 percent on average during the same period. In Somalia, for instance, the real value of the lowest salary and of the highest salary in the civil service in 1985 was only 5.2 and 4.0 percent of their 1975 value, respectively (ILO 1990).

Public enterprises may also be required to act as employers of last resort. To reduce unemployment, governments often guarantee jobs and provide funds to hire graduates, which make these employees costless for public enterprises. In Egypt such a policy has resulted in significant overstaffing (Gelb, Knight, and Sabot 1991). Similar employment policies are found in Central African Republic, Guinea, Mali, Senegal, Sudan, and Togo, where university graduates are automatically hired by public institutions.

Collectively, these factors have resulted in considerable overstaffing among public enterprises in many countries. A comparison of public and private manufacturing enterprises in Turkey has shown the existence of significant labor and capital surplus among public manufacturing enterprises: the ratio of public to private labor and of capital inputs per unit of output was 1.97 and 1.66, respectively (Gelb, Knight, and Sabot 1991: 1187). Overstaffing in the public sector in Egypt was as high as 40 percent in 1976. In part, this reflected the provision of funds to hire graduates, which made these employees costless for public enterprises (Gelb, Knight, and Sabot 1991). As a consequence, whereas employment in Egypt's private sector grew only 7.8 percent, it rose 24.5 percent in public enterprises during 1976–86 (Banerji and Sabot 1993). Overstaffing in particular sectors is estimated to be as high as 93 percent in the spinning industry of Egypt, 54 percent in the transport sector of Ghana, 91 percent in the Bombay port of India, and 40 percent in the railway sector of Turkey (Banerji and Sabot 1993).

Negative Profits

Public enterprises are frequently not expected to make a profit. Noneconomic objectives such as employment or equity appear to outweigh efficiency considerations, making public enterprises a significant burden on the government budget. Gross operating profits of public enterprises in nearly all developing countries were significantly negative between 1978 and 1991 (Galal 1994). Negative gross operating profits were between 2 and 3 percent of gross domestic product (GDP) in Africa and Asia for the period 1978–91. There was little or no improvement during the 1980s in Asia or Africa. Only in Latin America did gross operating profits improve significantly between 1978 and 1991, from negative gross operating profits of more than 1 percent of GDP between 1978 and 1985 to a small surplus between 1986 and 1991.

V. The Model for Public Enterprises

In contrast to the pure profit-maximizing behavior of the private sector, public enterprises are assumed to maximize a modified measure of profits:

$$\pi(\theta_i;\lambda w) = \max_L p\theta_i F(K,L) - \lambda wL - rK. \tag{9}$$

Here λ is an exogenously given measure reflecting the net influence of a concern with the wage bill (employment generation and wages), on the one hand, and recognition of the need for fiscal discipline, on the other. If λ equals 1, the government has no special employment objective or the fiscal constraint dominates or both. In this case, public enterprises are required to maximize profits. With a more pressing national employment objective and a more relaxed fiscal situation, λ may approach 0, at which point labor becomes costless to the enterprise. This implies overstaffing and a drain on the central budget. In exceptional circumstances, λ could be negative.

Alternative specifications of the objective function of public enterprises are possible and would yield different implications. Public enterprises may have an employment objective (to alleviate unemployment) or a high wage objective. Our specification reflects both these considerations as well as the stylized fact of high wage bills.

Compliance with Minimum-Wage Laws

Unlike private firms, the choices open to public enterprises with respect to labor market regulations may be more severely circumscribed. We can distinguish three different institutional arrangements. First, public enterprises may have little control over their wage and employment decisions. There may be a central wage-fixing and wage-paying body that applies to all public enterprises. In this case, public enterprises will comply with minimum-wage laws because they have no choice. Or there may be a virtual prohibition on firing workers in public enterprises, in which case increases in the minimum wage will reduce

profits or increase losses. Second, each public enterprise may have the capacity to choose between the minimum wage and the market wage, but the effective penalty or probability of inspection may be higher for public enterprises. If it is easier for government regulatory authorities to ensure payment of fines by public than by private firms, for example, the effective penalty will be higher for public firms. Recourse to nonpecuniary measures—for example, firing of public managers—could also result in higher effective penalties for public than for private firms. Alternatively, the probability of inspection β could differ. Labor may be more aware of its rights in a public enterprise or have a higher expectation that its grievances will receive attention. If so, the frequency of complaints, and hence of inspections, may be greater for public enterprises. These factors will increase the likelihood of compliance.

A third possibility is that the determination of wage payments is left to the enterprise as before but that the effective penalty and probability of inspection are the same for public and private firms. Because this case offers the most immediate comparison with private firms, we pursue it here to see whether public enterprises are more likely to comply than their private counterparts. If the answer is "yes," then we know that public enterprises are more likely to comply than private firms for *all* institutional arrangements because public enterprise compliance will be lowest for the particular one under study.

To examine this issue, we note that the general form of the results for public enterprises is identical to that for private firms. In particular, we can derive two inequalities similar to inequalities 3 and 4 to determine whether public enterprises will comply, evade, or avoid. The only difference is that the left side of these inequalities will reflect the modified objective function:

$$\pi(\theta_i;\lambda w) - \pi(\theta_i;\lambda\overline{w}). \tag{10}$$

In both inequalities the right side is the same for public as for private firms, and so, as before, we will observe evaders among public enterprises if inequality 5 holds. In the following, we assume that it does hold.

These similarities (on the right side) and differences (on the left side) allow us to shed light on whether public enterprises are more or less likely to comply than private firms. To see this, note that the relevant margin is the compliance/evasion one and from equation 9, for $\lambda = 1$, the private and public firm problems are identical. Therefore, if expression 10 is *decreasing* in λ, then we know that public enterprises—for which in general $\lambda < 1$—have *less* incentive to evade and more incentive to comply than private firms. This result holds, all things being equal, obviously, in particular, for a given θ_i.

Let $L(w, \theta_i; \lambda)$ solve equation 9. Then, expression 10, which reflects the incentive to evade, can be written as

$$-\lambda[wL(w,.) - \overline{w}L(\overline{w},.)] + p\theta_i\{F[\overline{K}, L(w,.)] - F[\overline{K}, L(\overline{w},.)]\}. \tag{11}$$

To assess how the incentive to evade changes with the degree of fiscal discipline and the concern with employment, differentiate expression 11 with respect to λ.

Using the envelope theorem, this yields $\overline{w}L(\overline{w},.) - w\,L(w,.)$. With inelastic labor demand, this expression is positive, and the incentive to evade decreases as the social concern with employment increases, fiscal discipline is relaxed and λ is reduced, or both occur. With elastic labor demand, the expression is negative, and the incentive to evade increases as the social concern with employment increases, fiscal discipline is relaxed and λ is reduced, or both occur. Thus, public enterprises are more likely to comply with minimum-wage legislation than their private sector counterparts in situations where the demand for labor is inelastic. This makes intuitive sense. For any positive λ, an inelastic demand curve implies that compliance results in a higher wage bill, which in turn lowers the objective function for both private and public firms. From equation 9, however, any given increase in the wage bill will lower the value of the objective function of public enterprises less than that for private firms because $\lambda < 1$, which reflects the fact that the wage bill is less "costly" in the public enterprise objective function because of relaxed fiscal discipline. Empirical estimates of the wage elasticity of labor demand in manufacturing typically produce absolute values well below 1 (see, for example, the estimates provided in Bell 1994: tables 7 and 8, or in Revenga 1994: table 10). These values indicate that in general public enterprises are indeed more likely than private firms to comply with labor market regulations even when confronted with the same regulatory environment.

Public Enterprise Compliance and Efficiency

If public enterprises are more likely than private firms to comply with minimum-wage legislation, then are efficiency losses greater for public enterprises? Here we show that the factor that leads to the result on compliance also has implications for the efficiency impact. To see this, consider the relationship between public enterprise compliance and labor demand. The first-order condition for a complying public enterprise is given simply by $\theta_i p F_L(K, L) = \lambda\,\overline{w}$, while that for an equivalent noncomplying private firm is given by $\theta_i p F_L(K, L) = w$. Denote the latter solution as L^*. The complying public enterprise therefore hires less labor than L^* if $\lambda \geq w / \overline{w}$ (and hires more labor if $\lambda < w / \overline{w}$).[4] This outcome reflects the fact that λ and w exert opposing forces on labor demand—λ increases labor demand, but w reduces it.

Evaluated purely from the standpoint of productive efficiency, it appears reasonable to assume that efficiency losses increase the farther away L is from L^*. Evaluating this from a welfare standpoint requires an assessment of the alternative public enterprise objective function. It follows that the introduction of a minimum wage could reduce efficiency losses for complying public enterprises as they move away from a situation of excess labor demand and closer to the free-market equilibrium. In effect, public enterprises have too many workers, so a minimum wage that cuts employment is beneficial. Thus, $\lambda < w / \overline{w}$ is suffi-

4. Since $\overline{w} > w > 0$, $w / \overline{w} \in (0, 1)$ while $\lambda \in [1, -\infty)$, we know that there exists a critical value $\lambda^* = w / \overline{w}$.

cient but not necessary for compliance by public enterprises to *reduce* efficiency losses.[5] By contrast, in private firms, compliance *increases* efficiency losses. This contrast between public and private firms has noteworthy implications for policy. It suggests that from the standpoint of improving compliance, it is preferable to focus on public than on private enterprises because with public enterprises there are less likely to be increased efficiency losses that offset the gains in equity from greater compliance.

VI. Analyzing Labor Market Regulations: A Checklist

Based on the preceding analysis, the following checklist provides a means for heuristically evaluating the likely distortionary impact of minimum-wage regulations. Where the preliminary evaluation suggests significant distortionary costs, further research and analysis are needed.

- *Check whether the legislated minimum wage is potentially binding.* As empirical studies demonstrate, minimum wages are not likely to have significant employment or other effects if they do not "bite." One helpful exercise would be to consider the relationship of the minimum wage to the wage distribution. Wage histograms that spike at or near the minimum wage rather than significantly to the right indicate situations where the minimum wages have more bite. Such histograms for Morocco, differentiated by firm size, indicate, for example, that minimum wages are considerably less binding for larger than for smaller firms. Similarly, the fact that only 6 and 24 percent of firms had average wages below 1.5 and 2 times the minimum, respectively, in Mexico, but that 27 and 71 percent did so in Colombia indicates that minimum wages potentially had more bite in Colombia (data are for 1989 for Mexico and 1987 for Colombia, from Bell 1994). Although this check will give a preliminary indication, in practice there may be several complications. For example, several legislated minimum wages may correspond to different sectors or classes of firms. Furthermore, because the total return to labor includes both wage and nonwage elements, simple comparisons of average to legislated minimum wages may not capture the true extent to which the minimum wages are binding.
- *If the legislated minimum wage is potentially effective, check the extent of noncompliance.* To arrive at a quick assessment of the extent of noncompliance, it would be useful to interview the relevant staff in the country's department of labor. Their assessment of the situation could be supplemented with data on the size of the enforcement budget, the number of inspectors and prosecutions, and the severity of fines. It would also be

5. Public enterprise compliance does not always reduce efficiency losses because such firms could end up hiring so few workers that efficiency losses are greater under compliance than under noncompliance. Recall that for $\lambda = 1$ public enterprise behavior is identical to private firm behavior. Because compliance results in efficiency losses for private firms, public enterprise compliance at $\lambda = 1$ results in efficiency losses.

useful to check the relevant legislation to establish the scope for easy and legal avoidance through such means as use of temporary workers, apprentices, or subcontracting. As a cross-check, a small survey of selected enterprises in different segments (private/public, formal/informal) would be desirable. In addition to government administrative capacity, strong labor unions and judicial systems may also play an important role in determining the effectiveness of enforcement. In Ecuador and Morocco, for example, unions reportedly act as important channels for transmitting complaints regarding violations of labor regulations. In the United States, many plaintiffs take cases of violations directly to court without involving the Department of Labor.

- *If the legislated minimum wage is binding and enforced, check the relative size of the public and private sectors.* If the private sector predominates, then the evidence already compiled provides a basis for concluding that distortionary costs are potentially significant and that further analysis is required. If, instead, the public sector predominates, one more test is required because in this case the efficiency impact depends on the net strength of the employment objective and the fiscal constraint. One indication of the net strength of these factors is the extent of net financial flows from government to public enterprises. High figures could indicate a looser fiscal constraint. For example, as a proportion of GDP in 1978–91, these figures were 2.5 percent for Argentina, but −12.1 percent for Chile, and 16.6 percent for Algeria, but −6 percent for Egypt (Galal 1994). In the event that public enterprises appear to operate like profit-maximizing private firms, then, as with private firms, the evidence would point to potentially significant efficiency losses and would call for further investigation.

To conclude, we return to the opening quote from Freeman. In our checklist we have set out three conditions that have to be fulfilled *before* we can expect to see significant distortions associated with legislated minimum wages. It is our presumption that in many developing countries these conditions are unlikely to be fulfilled. If this is true, then Freeman's surprise at the lack of evidence regarding the distortionary costs of minimum wages is explained, at least as far as broad, cross-country comparisons are concerned. Such costs could, however, still be significant in some countries at some times.

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Economic Reform and Labor Unions: A General-Equilibrium Analysis Applied to Bangladesh and Indonesia

Shantayanan Devarajan, Hafez Ghanem, and Karen Thierfelder

Noting the trend toward more independent trade unions in developing countries, this article examines whether the presence of unions strengthens or weakens the benefits to be gained from economic policy reform. We show that the presence of "passive" unions—ones that choose their wage-employment contract given the firm's cost-minimizing strategy—increases the welfare gains from trade liberalization, because trade reform lowers the wage premium enjoyed by the unionized sector, reducing a distortion in the labor market. These gains are amplified when the unions are "active," namely, when they negotiate a contract with the firm that is off its labor demand curve. Such a contract results in featherbedding—paying workers more than their marginal product—and trade reform reduces the amount of featherbedding. The policy implication for Bangladesh—a country with strong trade unions and a protected unionized sector—is that the benefits of further trade liberalization may be greater than otherwise predicted. In Indonesia, where both unionization and import tariffs are low, allowing greater independence to unions may preserve flexibility and reward workers better than the current minimum-wage policy.

The world is moving toward more openness, political freedom, and civil liberties. Freedom of association and organization is now accepted as a basic human right in most societies. In many developing countries, workers have increased their demands for the right to associate, organize freely, and bargain collectively. Independent trade unions are now appearing in countries where in the recent past only state-sponsored unions were allowed. The transitions toward democracy and independent trade unions in Chile and Korea in the late 1980s are dramatic examples of this process. While the share of unionized labor in the workforce has been declining in many industrial countries, at least partly as a consequence of the increasing share of services in total employment, it has been rising in developing countries because of greater industrialization and democratization.

Shantayanan Devarajan is with the Policy Research Department at the World Bank, Hafez Ghanem is with the Europe and Central Asia Country Department IV at the World Bank, and Karen Thierfelder is with the Department of Economics at the U.S. Naval Academy. This article was originally prepared as a background paper for *World Development Report 1995: Workers in an Integrating World*. The authors are grateful to three anonymous referees for comments on an earlier version.

The political and social effects of independent trade unions are generally thought to be positive. Unions fought for democracy in Poland, equality and the end of racial segregation in South Africa, and national independence in Bangladesh, India, and Sri Lanka. The impacts of labor unions on efficiency, equity, and growth, however, are not clear. (For a detailed discussion of the economic effects of unions see Freeman and Medoff 1984.) On the one hand, unions can act as monopolists, increasing their members' wages and discouraging investment and job creation. The wage premia that unions obtain for their members are often at the cost of slower growth and lower wages and employment for unorganized workers (see Blanchflower and Freeman 1990, Moll 1993, Panagides and Patrinos 1994, Park 1991, Standing 1992, and Teal 1994). On the other hand, Freeman (1980), Lee and Nam (1994), and Panagides and Patrinos (1994) present evidence that unions improve the distribution of income and reduce discrimination against women and ethnic minorities. Other evidence (Standing 1992) indicates that unions can help raise productivity and improve competitiveness.

This article does not address the question of whether unions are "good" or "bad" for development. Taking as given the fact that independent trade unions are going to play a more important role than they did in the past, we explore the implications of this fact for economic policy. This focus is relevant for analytical and policy reasons. On the analytical side, economic reform in developing countries has typically been evaluated assuming that labor markets are perfectly competitive (see, for example, Devarajan, Lewis, and Robinson forthcoming). This assumption is becoming increasingly heroic. How would the results change when union behavior is explicitly incorporated into the analysis? We develop a stylized, two-sector general-equilibrium model and graft onto it different types of unions. "Passive" unions take the firm's labor demand curve as given and determine the optimal wage markup, similar to unions in de Melo and Tarr (1992). "Active" unions negotiate a wage and employment contract that captures some of the inframarginal rents, as described by McDonald and Solow (1981) and Johnson (1990). In active unions, firms are off their labor demand curves, and featherbedding occurs as excess labor is hired and workers are paid more than their marginal product. We test whether the outcome of economic reform is different under each of these specifications of union behavior.

Although the analytical motivation of the exercise is clear, the policy relevance requires some explanation. After all, most workers in developing countries are in the rural and informal sectors where unions do not exist. Formal sector employment is only around 17 and 57 percent of total employment in low- and middle-income countries, respectively. Nonetheless, there are two reasons to pay attention to the role of unions. The first is particularly relevant to low-income countries in South Asia and Africa, where the strategic importance of the unionized sector is much greater than is indicated by its share in total employment or gross domestic product (GDP). For example, Bangladesh's manufacturing sector represents only around 10 percent of GDP, but manufacturing is

by far the most important foreign-exchange earner, responsible for some 70 percent of exports. Trade unions in Bangladesh are particularly important in manufacturing, especially textiles (cotton and jute). Jute, which represents around one-third of net exports, has been in a crisis caused by low competitiveness and high unit labor costs, and the government has embarked on a massive restructuring program. (See World Bank 1995 for estimates of unit labor costs in Bangladesh's jute industry and comparisons with other Asian countries.) Understanding the structure of the labor market, including the role of unions, and its links with the rest of the economy is key to the success of this effort. Other examples of strategic sectors in less-developed countries where labor unions play an important role include the textiles industry in Egypt, coal mines in India, and oil extraction in Nigeria.

The second reason is particularly relevant for fast-growing middle-income countries in East Asia and Latin America. Those countries exploited their comparative advantage in labor-intensive goods to achieve rapid growth in exports and overall growth. Often they did not allow independent unions, which some argue helped to keep wages low and maintain competitiveness. There is increasing evidence that labor repression was not necessary for export expansion and economic growth in East Asia. (For example, see Fields 1994 or Freeman 1993.) But workers in many of these countries have become increasingly vocal in demanding free unions, and the international community is pressuring countries to respect workers' rights. Indonesia is a good example (as are China, Malaysia, and Singapore). Until recently, labor legislation in Indonesia limited the right to form unions, and only one large government-supported union, SPSI (Serikat Pekerja Seluruh Indonesia, the All-Indonesia Workers' Union), is operating. The Indonesian government is under domestic and international pressure to liberalize labor legislation. Understanding the implications of allowing new, more independent unions is key to enhancing worker welfare without jeopardizing Indonesia's tremendous economic achievements.

Building on the insights of a stylized model, we analyze the interaction between union behavior and economic policy in both Bangladesh and Indonesia using more detailed, country-specific models. In Bangladesh, unions are free, but markets are heavily protected. Although only about 3 percent of the labor force is unionized, unions are powerful players in the labor market. They have strong ties to political parties and are concentrated in urban centers where they can exert pressure on government. Particularly strong in highly protected or subsidized sectors, unions have been increasing their pressure on the government to ensure continued protection and support. This pressure has taken the form of widely publicized nationwide strikes and *hartals* (lockouts with civil protest), which have given industrial relations in Bangladesh a bad name. How does this situation affect the economic reform process? The existence of militant unions clearly raises the political cost of economic liberalization policies.

In contrast, Indonesia has adopted more market-friendly policies and low levels of protection. This has led to a boom in manufacturing exports and for-

eign direct investment and has put Indonesia on the path to rapid export-oriented, labor-intensive growth. The government has resisted pressure to liberalize labor laws and has tried to ensure workers' political support by increasing legislated benefits. Minimum wages were raised substantially every year between 1989 and 1994, almost tripling (in nominal terms) during this period. The government also introduced a Workers' Social Security Law including life insurance, retirement benefits, free health care, and workers' compensation, raising labor costs 12 percent. Yet, labor unrest continues to rise; the number of workdays lost because of (mostly illegal) strikes increased thirty-fivefold between 1989 and 1992.

In section I we describe the changes in the labor market when there are either passive or active unions. We present a stylized model with each type of union behavior. In sections II and III we describe the computable general equilibrium (CGE) models and simulation results for Bangladesh and Indonesia, respectively. Section IV concludes.

I. Stylized Model

To focus on the effects of various types of union behavior, we begin with a simple, two-factor, two-sector general equilibrium model. The two sectors are agriculture (A) and manufacturing (M), with manufacturing being the protected sector. Each sector produces output by a production function using the two factors, labor (L) and capital (K):

$$X_A = f(L_A, K_A) \tag{1}$$

$$X_M = g(L_M, K_M). \tag{2}$$

Capital is fixed and sector-specific. Factor supplies are held constant to focus on the static efficiency gains from trade liberalization. Allowing factor supplies to be endogenous requires an explicit intertemporal model. Devarajan and Go (forthcoming) show that in such a model the welfare effects are not very different. That capital is sector-specific is also not crucial (Devarajan and Offerdal 1989). Here labor is the only mobile factor. The supply of labor is fixed:

$$L_A + L_M = L^*. \tag{3}$$

Although labor is mobile, we observe a difference in the returns across sectors:

$$w_A = P_A f_{L_A} \tag{4}$$

$$w_M = P_M g_{L_M}. \tag{5}$$

Whether we attribute this difference to productivity differences or union premia will play a crucial role in the analysis.

We can define the average wage, w, as the wage that solves:

$$w_A L_A + w_M L_M = wL^*. \tag{6}$$

We can now define the wage premium, ϕ, in each sector as the sector's wage relative to the average wage:

$$\phi_A = \frac{w_A}{w} \tag{7}$$

$$\phi_M = \frac{w_M}{w}. \tag{8}$$

In what follows, we assume that the ϕs are exogenous for the benchmark (no-union) case. This implies that the observed differences in labor productivity will remain even after labor is reallocated between sectors. We assume that these differences are caused by sectoral attributes (such as differences in technology or capital stock) rather than by individual characteristics. Consequently, there will be welfare costs, or second-best effects, if labor moves from a high-productivity to a low-productivity sector following a policy shock. This specification of the labor market allows us to maintain the factor payment differentials observed in the base data, which are an important feature of the actual country models. For the union cases, we assume that ϕ_M is the outcome of the union's optimizing behavior (for passive unions) or the outcome of a bargaining solution between unions and management (for active unions). In these cases, the premium can change following a policy change, giving rise to different welfare effects.

The demand side of the stylized model is standard. Imports and domestically produced goods in the same sector are imperfect substitutes (see, for example, Devarajan, Lewis, and Robinson forthcoming). The single, representative consumer allocates expenditure in fixed shares over the "composite commodities" (a constant elasticity of substitution—CES—aggregate of imports and domestic goods). The small country faces exogenous world prices in both exports and imports. There is a tariff on imports of manufactured goods. All income accrues to the representative consumer, including the tariff revenue collected, which is rebated in a lump-sum fashion.

Passive Unions

To incorporate union behavior, we attribute all differences in payments to labor in the manufacturing sector to a union markup, $\phi_M > 1$. The union chooses this markup to maximize its utility subject to the firm's labor demand curve. The payment differential to labor in agriculture is constant ($\phi_A < 1$).

The passive union takes the derived demand for labor as given and chooses the wage premium that maximizes its utility over wages and employment. Fol-

lowing de Melo and Tarr (1992), we assume that the union has a Cobb-Douglas utility function:[1]

$$U = (w\phi_M - w)^{\mu}(L - \overline{L}_i)^{(1-\mu)} \tag{9}$$

where U is the union's utility over wages and employment; w is the minimum acceptable wage, which we take to be the economywide average wage; ϕ_M is the wage premium paid to union workers; L is the number of workers hired; and $\overline{L}_i$ is the minimum acceptable employment for union type i, which equals P if passive and A if active.

Manufacturing output, X_M, is produced using a CES function over two inputs, labor (L) and capital (K):

$$X_M = \overline{A}[\alpha L_M^{-\rho} + (1-\alpha)K_M^{-\rho}]^{(-1/\rho)}. \tag{10}$$

The elasticity of substitution between labor and capital in production is:

$$\sigma = \frac{1}{(1+\rho)}. \tag{11}$$

Given this production technology, the derived demand for labor is:

$$L = \left(\frac{\alpha P_M X_M}{\phi_M w}\right)^{\sigma}\left(\frac{X_M}{\overline{A}}\right)^{(1-\sigma)} \tag{12}$$

where P_M is the output price of manufacturing. Substituting the labor demand curve into the union's utility function and choosing the wage premium to maximize utility, we find that the optimal wage premium ϕ_M solves:

$$\frac{(\phi_M - 1)}{\phi_M} = \frac{\mu}{(1-\mu)\sigma}\frac{(L - \overline{L}_P)}{L}. \tag{13}$$

The endogenous wage differential creates an additional channel for welfare changes following a policy shock such as trade liberalization. For example, as the demand for labor in the union sector declines, the wage differential declines, reducing the labor market distortion. This contributes to the welfare gains from the policy shock.

Active Unions

McDonald and Solow (1981) demonstrate that the wage and employment level chosen with a passive union is not efficient. Consider a union with the utility

1. de Melo and Tarr (1992) use passive rather than active behavior to describe unions in the U.S. auto and steel industries because they find little evidence that U.S. producers in these sectors are off the derived demand for labor.

function described in equation 9; a passive union will maximize its utility at point A in figure 1.[2] However, the union can be made better off, and the producer no worse off, with a different combination of wages and employment. For example, consider the isoprofit curve—the locus of wage-employment combinations that yields the same profit to the firm—through A. There are points on this isoprofit curve that are preferred by the union. In equilibrium, the union's indifference curve will be tangent to the producer's isoprofit curve (point B). Note that the equilibrium wage and employment are not on the derived demand curve for labor. The set of equilibrium points—where the producer's isoprofit curves and the union's indifference curves are mutually tangent—defines the contract curve. We maintain sector-specific capital so profit is the return to capital. To derive the equilibrium wage markup (ϕ_M), first consider the producer's profit function (where π equals profit) treating manufacturing as the unionized sector:

$$\pi = P_M f(L, K) - \phi_M w L. \tag{14}$$

The slope of the profit function is:

$$dW/dL = \frac{(P_M f_L - \phi_M w)}{L} \tag{15}$$

where $W = \phi_M w$. From the union's utility function in equation 9, the slope of the indifference curve is:

$$dW/dL = \frac{(\mu - 1)}{\mu} \frac{(\phi_M w - w)}{(L - \overline{L}_A)}. \tag{16}$$

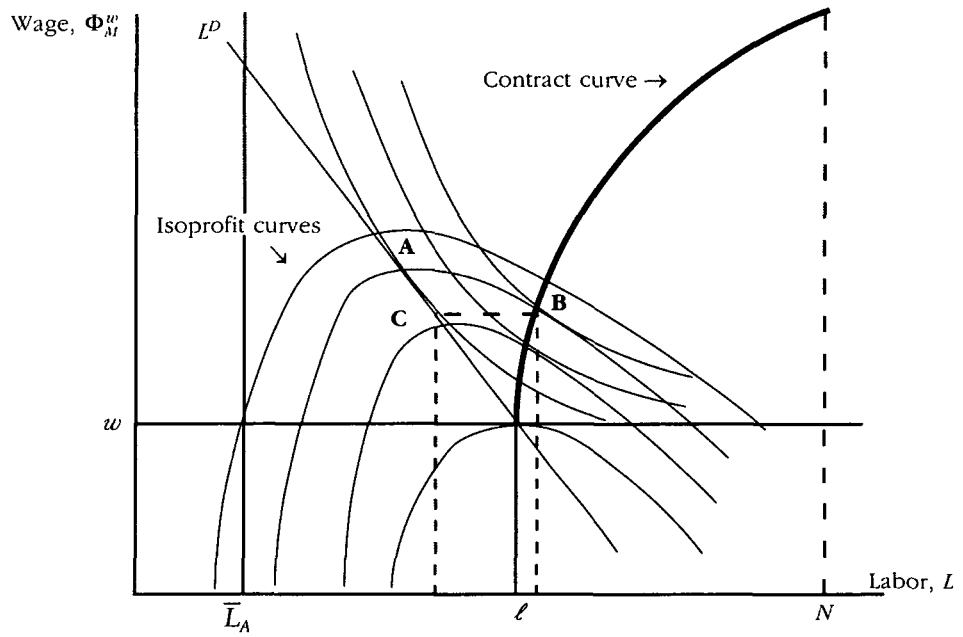
Equating equations 15 and 16, we define the contract curve as the locus of points ($\phi_M w, L$) satisfying:

$$\frac{(P_M f_L - \phi_M w)}{L} = \frac{(\mu - 1)}{\mu} \frac{(\phi_M w - w)}{(L - \overline{L}_A)}. \tag{17}$$

The union bargains with the producer to hire more labor at a given wage than the firm would otherwise have at that wage. This excess labor can be described as featherbedding. Note that there is "excess" labor relative to the case with no unions at the same wage. If the reference point is the passive union, the producer may well be gaining with an active union. In terms of figure 1, excess labor is the horizontal distance between point B on the contract curve and point C on the derived demand for labor, at the agreed upon wage. As shown in figure 1, the contract curve has a positive slope. Under certain conditions, it can have a negative slope. However, because the contract curve is to the right of the labor demand curve, featherbedding is always positive.

2. Our utility function differs slightly from that in McDonald and Solow (1981). We include a minimum acceptable employment level as well as the minimum acceptable wage level that they include.

Figure 1. *Active Union Behavior*



The point on the contract curve at which the firm and union agree depends on the relative bargaining strengths of the two. McDonald and Solow (1981) describe two extreme cases: a dominant union and a dominant firm. In the case of the dominant union, equilibrium is reached at the point on the contract curve associated with zero profit for the producer. When the firm is dominant and the union has no bargaining strength, the firm faces w, the union's minimum acceptable wage, and maximizes profit at l. This is the level of employment and wage at which the labor market is competitive, which we take to be the point at which the union has no bargaining power.

To summarize, we describe the union's bargaining strength as θ, the ratio of the wage it received from the bargaining process to the wage it would get ($w_{\max}$) if *all* revenues accrued to labor:

$$\theta = \frac{\phi_m w}{w_{\max}} \tag{18}$$

where

$$w_{\max} = \frac{P_M X_M}{L} \tag{19}$$

where $P_M X_M$ equals revenue from sales; as θ approaches 1, the union dominates.

Because both the contract curve and the derived demand for labor shift following a policy shock, we cannot determine, a priori, the change in featherbedders following a policy shock that changes output in the unionized sector. In the case

Table 1. *The Structure of the Stylized Model*

Item	*Value*	
	Agriculture	*Manufacturing*
Tariff	0.00	0.30
Output share	0.50	0.50
Share of sectoral value added paid to capital	0.75	0.41
Share of sectoral value added paid to labor	0.25	0.59
Share of capital employed by sector	0.40	0.60
Share of labor employed by sector	0.65	0.35
Wage differential	0.40	1.75

with active unions, the producer shares the return to capital (profit) with union labor.[3] Table 1 provides a description of the structure of the model.

Simulation Results

We simulate trade liberalization (removing the 30 percent tariff protecting the unionized sector) in the stylized model with various assumptions about union behavior. In the case with no unions, imports of the formerly protected good increase 31.3 percent and domestic production declines 1.1 percent (see table 2). Exports of both goods increase to maintain the exogenous trade balance. Despite the elimination of the trade distortion, there are no welfare gains. We define welfare as equivalent variation, the amount the consumer would be willing to pay to consume at the original prices before the policy shock. With this specification, a negative number indicates a welfare gain. However, for reporting purposes, we change the sign so that a positive number indicates a welfare gain. As the economy adjusts to the policy shock, labor moves into low-productivity agriculture and out of high-productivity manufacturing, counteracting the welfare gain created by removing the trade distortion. By coincidence, in table 2 the labor market distortion effects exactly offset the welfare gain from trade liberalization.

With passive unions, output and trade change in the same direction as in the model with no unions (table 2). (We assume that the slope of the labor demand curve falls in absolute value more slowly than that of the union's indifference curve, so that second-order conditions are satisfied.) Trade liberalization shifts the derived demand for labor in the union sector downward, reducing the labor market distortion and generating welfare gains (see equivalent variation in table 2). The decline in manufacturing output is smaller, compared with the model with exogenous wage differentials, because labor costs decline as the union premium declines (see wage differentials). Likewise, the decline in the demand for labor in manufacturing is smaller than it is in the model with exogenous wage differentials.

3. The calibration programs for the two different union models are available from the authors on request.

Table 2. *The Impact of Removing the 30 Percent Tariff in the Manufacturing Sector under Alternative Specifications of the Labor Market*

	Exogenous wage differentials (no unions)		*Passive union*				*Active union*		*Active union and bargaining*	
			μ = 0.3		*μ = 0.9*					
Item	*Agriculture*	*Manufacturing*	*Agriculture*	*Manufacturing*	*Agriculture*	*Manufacturing*	*Agriculture*	*Manufacturing*	*Agriculture*	*Manufacturing*
Percentage change from base level										
Employment	1.01	−1.88	0.82	−1.53	0.07	−0.13	0.49	−0.51	−0.29	9.44
Real market-clearing wage	1.10	1.10	1.39	1.39	2.56	2.56	1.98	1.98	4.64	4.64
Featherbedders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	−0.82	0.00	−18.16
Wage differential	0.00	0.00	0.00	−0.58	0.00	−2.87	0.00	−1.99	0.00	−11.58
Real sectoral wage	1.10	1.10	1.39	0.80	2.56	−0.38	1.98	−0.05	4.64	−7.47
Real sectoral return to capital	2.63	−1.74	2.64	−1.50	2.67	−0.58	2.73	−0.81	4.18	5.93
Output	0.25	−1.11	0.20	−0.90	0.02	−0.08	0.12	−0.30	−0.07	5.39
Exports	15.90	19.71	15.67	20.15	14.75	21.90	15.11	21.40	11.08	32.94
Imports	−16.39	31.31	−16.27	31.32	−15.77	31.35	−15.90	31.38	−12.39	32.55
Equivalent variation[a]	0.01		0.17		0.81		0.70		6.19	

a. Measured in units of the numeraire good. Equivalent variation is a weighted average over households, and a positive value indicates a welfare gain.
Source: Authors' calculations.

Figures 2 and 3 show the difference between the no-union and union cases. In figure 2, M's labor demand curve slopes from left to right, while A's labor demand curve slopes from right to left. The initial equilibrium is portrayed as (w_M, w_A). With no unions, the difference between w_M and w_A remains constant, so that for a given downward shift in M's labor demand (because of trade liberalization), the new wages are w'_M and w'_A.

With a passive union, the initial equilibrium (also w_M, w_A) is determined by the tangency between the union's indifference curve and L_D^M (figure 3). When the labor demand curve shifts downward, the new point of tangency with the union's indifference curve is at a lower manufacturing wage w''_M. The wage differential has narrowed, implying that manufacturing does not contract by as much as in the no-union case.

Interestingly, when there is a high weight on wages in the union's utility function, there is a bigger decline in the wage differential than when there is a low weight on wages—a decline of 2.9 percent rather than 0.6 percent. The smaller wage differential translates into a larger welfare gain when the weight on wages is high; the change in equivalent variation is 0.8 rather than 0.2 in the low-weight case. As a result of the decline in the wage markup, the payment to labor in manufacturing declines 0.4 percent when the union cares more about wages than employment. It increases 0.8 percent when the union cares more about employment than wages. Likewise, fewer union jobs are sacrificed in the high-

Figure 2. *The Impact of Trade Liberalization on Employment and Wages in the Case with No Unions*

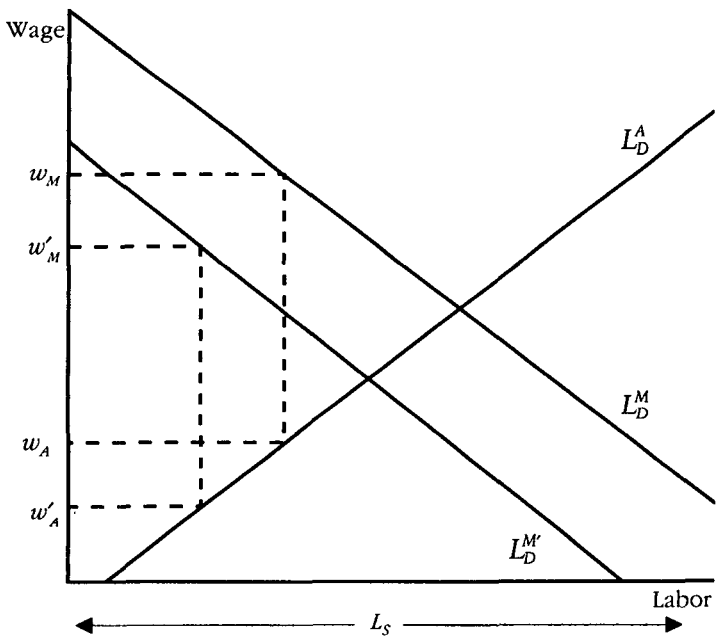
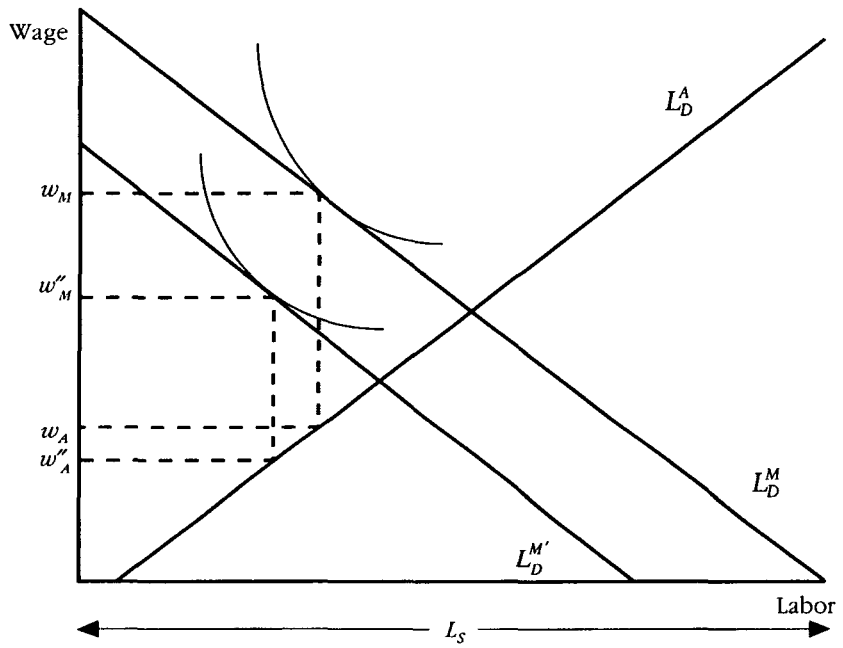


Figure 3. *The Impact of Trade Liberalization on Employment and Wages in the Case with Unions*



weight version of the passive union—they decline 0.1 percent rather than 1.5 percent.

This may seem like a counterintuitive result: a union that cares more about wages, as represented by a higher weight on wages in its utility function, sacrifices the wage premium rather than employment when the sector contracts. To resolve this apparent paradox, recall that the union has both a minimum acceptable wage and employment level in its utility function. We take the minimum acceptable wage to be the economywide average wage. The unobserved parameter is the union's minimum acceptable employment level, $\bar{L}_P$. We therefore calibrate this parameter from the observed wage and employment levels and the other parameters of the union's utility function (including the weight on wages, μ). Thus, a higher μ implies a higher $\bar{L}_P$ for consistency with the observed wage and employment levels. It follows that in response to a negative shock, with a higher weight on wages, employment has less "room" to fall, so that the adjustment occurs in wages. This paradox appears in de Melo and Tarr (1992) and Thierfelder and Shiells (1996).

With active unions and the removal of protection, the wage differential declines 2.0 percent. The number of productive workers in the economy increases as the number of featherbedders declines 0.8 percent. The changes in output, trade, and factor allocation resemble those in the model with no unions. Be-

cause of the reduction in labor costs, manufacturing output declines 0.3 percent, which is less than the decline in the case with exogenous wage differentials. Similarly, the demand for labor declines 0.5 percent, less than in the case with exogenous wage differentials, in which the demand for labor in manufacturing declines 1.9 percent.

Suppose that, anticipating the trade liberalization, the union makes some concessions in terms of its bargaining strength. This scenario produces more dramatic results. The supply of productive labor increases as the number of featherbedders declines 18.2 percent. The demand for labor in manufacturing increases 9.4 percent. The market-clearing wage increases 4.6 percent, indicating that the changes in labor demand dominate the increase in labor supply. However, given the 12.0 percent decline in the union premium, the wage for workers in the manufacturing sector declines 7.5 percent. The labor market changes dominate tariff elimination: output in the formerly protected sector actually increases 5.4 percent, while output of the other sector declines slightly (0.07 percent). This is the only scenario in which the return to capital in manufacturing increases, reflecting the increase in manufacturing output.

Two changes in the labor market affect output in the formerly protected sector: (1) the wage differential declines in the union sector and (2) the supply of labor increases. To decompose the effects, we consider trade liberalization in the model with an exogenous wage differential. We reduce the wage differential to the level observed in the case with trade liberalization and union concessions. We find that output of manufacturing increases because of the decline in labor cost. Manufacturing output increases more (and agricultural output declines less) when the labor supply adjusts because of the decline in the number of featherbedders.

Simulations with the stylized model lead to four general conclusions:

1. Loss of protection in the unionized sector results in additional welfare gains from trade liberalization.
2. With passive unions, the reduction in the union wage premium results in welfare gains, whose magnitude depends on union preferences.
3. With active unions, both the decline in the wage differential and the fall in the number of featherbedders contribute to the welfare gain.
4. If unions make bargaining concessions, the labor market changes can dominate the effect of tariff elimination on output.

II. Bangladesh

The structure of the labor market and the role of unions in Bangladesh are representative of those in other South Asian countries. Bangladesh has three types of labor markets: formal, rural informal, and urban informal. The formal labor market is characterized by a contractual employment relationship and governed by labor laws and regulations that aim to protect workers, such as minimum wages and allowances and limitations on the employer's ability to fire

employees. The rural and urban informal labor markets are not covered by protective labor regulations. The informal sector dominates the labor market. In 1991, 47.2 percent of the labor force were classified as unpaid family workers, 15.4 percent were classified as self-employed, 13.9 percent were classified as casual workers (day laborers), and only 11.7 percent had regular full-time wage employment.[4]

Despite the small size of the formal sector, Bangladesh has a large number of labor unions. In 1992, there were 4,065 registered unions, with a total membership of 1,648,783, which represents some 3 percent of the labor force. The unions are organized into roughly 700 union federations. Almost all federations have links with political parties, with the three largest federations acting as the labor front of the three major parties. (For a more detailed description of the labor movement in Bangladesh, see Rahman 1994.) Unions and union federations are very active in Bangladesh's political and economic life. They were key partners in the coalition that ended the rule of General Ershad and restored democracy to Bangladesh in 1991. On the economic front, they entered into agreements with government in 1984, 1991, and 1992 to raise legislated labor benefits and protections.

For most of Bangladesh's existence, the government has provided high protection to domestic industries. In the late 1980s the average manufacturer selling its products domestically enjoyed more than an 80 percent effective protection rate from tariffs alone. Some industries—like textiles, soap and detergents, and iron and steel—were even more highly protected by both tariffs and quantitative restrictions on imports. The situation started to change in the 1990s. In 1992 import discriminating taxes other than customs duties were replaced by the largely trade-neutral value added tax and supplemental duties; with some exceptions, the maximum tariff rate was reduced steadily from 400 percent to around 50 percent; and many quantitative restrictions were removed. More trade liberalization is being discussed in Bangladesh, including further reduction and compression of customs duties, removal of remaining trade-related quantitative restrictions, and reforms to facilitate the process of import clearance.

As can be expected, there is a lot of political resistance to trade liberalization in Bangladesh, much of it from labor unions. The existence of strong labor unions in Bangladesh clearly increases the political cost of trade liberalization. How does it affect the economic benefits to be gained from liberalization? To answer this question, we turn to a more detailed general equilibrium model of Bangladesh, which has many of the core features of the stylized model in section I.

Model Description

Naturally, some of the features of the Bangladesh model are more complex, making the effects of a union less clear than in the case of the stylized model. Of the thirty-five sectors in the model, nine are unionized. The unionized sectors

4. Of the labor force, 11.4 percent are classified as "employers" and 0.4 percent are "not reported." The data references in this section come from Bangladesh Bureau of Statistics (1995).

are cotton yarn, paper, leather, fertilizers, cement, basic metals, metal products, petroleum, and electricity and gas. (See Devarajan, Ghanem, and Thierfelder 1995 and Dahl and Mitra 1991 for a more detailed description of the Bangladesh model.) The model contains a Cobb-Douglas production function over an aggregate of intermediate goods and a CES aggregate of four inputs: rural labor, urban informal labor, urban formal labor, and capital.

Capital is sector-specific, representing the producer's profit that is shared with the active unions. The assumption of sector-specific capital, which reflects the segmented nature of capital markets in Bangladesh, is not crucial (see Devarajan and Offerdal 1989). The original data for Bangladesh do not indicate capital use by sector. We construct the input capital by allocating some of the value added by the other labor inputs to it. Each of the three households in the base data receives income from one labor category. To maintain the households' structure, we restore the capital income (net of payment to featherbedders where applicable) to the appropriate household, based on the share of value added that each labor category contributed to the construction of capital input. When there are no active unions, the income to each household is identical to the case with no capital inputs.

Because there are intermediate goods, there is the potential for offsetting changes in demand following a policy shock such as trade liberalization. Production may not always decline in sectors where protection is eliminated. It can sometimes rise in response to increased demand from sectors that use the formerly protected good as an intermediate input.

The structure of protection also affects the distribution of output among the unionized sectors. In Bangladesh, not all unionized sectors receive protection (see table 3). For example, fertilizer and electricity and gas have zero tariffs. Likewise, some nonunion sectors receive protection. Unlike the stylized model, tariff elimination does not exclusively target production in the unionized sector.

In contrast to the stylized model, there are additional (nonunionized) labor groups in Bangladesh. There is potential for factor substitution in response to

Table 3. *Characteristics of Unionized Sectors in Bangladesh*

Sector	*Tariff*	*Share of output*	*Share of urban formal employment by sector*	*Share of sectoral value added paid to urban formal workers*
Cotton yarn	2.30	0.01	0.01	0.22
Paper	1.31	0.01	0.01	0.15
Leather	1.09	0.01	0.01	0.25
Fertilizers	0.00	0.01	0.03	0.36
Cement	0.41	0.00	0.01	0.33
Basic metals	0.56	0.01	0.04	0.38
Metal products	0.43	0.04	0.25	0.31
Petroleum	0.41	0.02	0.08	0.23
Electricity and gas	0.00	0.01	0.04	0.23

Source: Authors' calculations.

Table 4. *Macroeconomic Effects of Trade Liberalization in Bangladesh under Alternative Specifications of the Labor Market*

Item	Exogenous wage differentials (no unions)	Active union: No concessions	Active union: Low concessions	Active union: High concessions
Real market-clearing factor return (percentage change from base level)				
Rural	6.09	6.09	6.31	6.51
Urban informal	2.07	2.09	2.25	2.52
Urban formal	−0.56	−0.16	1.26	2.26
Capital	10.37	10.49	10.10	9.77
Real average factor return (percentage change from base level)				
Rural	6.08	6.07	6.30	6.50
Urban informal	2.75	2.75	2.94	3.22
Urban formal	−1.29	−1.42	−3.81	−5.88
Capital	5.47	5.46	5.74	6.00
Featherbedders	0.00	−1.52	−33.91	−63.75
Total exports	78.24	77.57	76.91	76.76
Total imports	30.91	30.73	30.56	30.54
Unemployment (share of urban formal labor supply)	0.00	0.00	0.00	0.00
Equivalent variation[a]	20.08	20.07	21.34	22.45

a. Measured in units of the numeraire good. Equivalent variation is a weighted average over households, and a positive number indicates a welfare gain.

Source: Authors' calculations.

changes in the cost of unionized labor. This implies stronger spillover effects on the returns to other labor groups.

Simulation Results

Tariffs in Bangladesh mainly protect the urban formal workers. In a model with no unions (the observed factor payment differentials are treated as exogenous), trade liberalization causes the real average return to urban formal workers to decline 1.3 percent, the real average return to rural labor to increase 6.1 percent, and the real average return to urban informal workers to increase 2.8 percent (see table 4).[5] The contracting sectors—such as cement, basic metals, and metal products, which had tariffs of 41, 56, and 43 percent, respectively—use urban formal workers relatively intensively.

If we assume that active unions in Bangladesh explain the observed wage differentials, the income distribution following trade liberalization changes slightly. The real return to urban formal workers decreases 1.4 percent rather

5. These numbers differ in magnitude but not direction compared with our earlier analysis of Bangladesh (Devarajan, Ghanem, and Thierfelder 1995). This model differs from the earlier model in that we introduce sector-specific capital and factor payment differentials for urban formal workers.

than 1.3 percent. The change is caused by the increased supply of productive urban formal workers, as the number of featherbedders declines 1.5 percent.

For the same reason, the factor allocation and production changes are not as extreme as when there are no unions. For example, the wage differentials for cement, basic metals, and metal products decline 4.7, 5.5, and 2.9 percent, respectively, in the model with active unions (see table 5). The less extreme changes dampen the decline in demand for urban formal labor in those sectors. Likewise, output for those sectors declines less than when there are no unions because of the decline in the cost of urban formal workers.

Table 5. *Effects of Trade Liberalization in Bangladesh under Alternative Specifications of the Labor Market for Unionized Sectors*

		Active union		
Sector	*Exogenous wage differentials (no unions)*	*No concessions*	*Low concessions*	*High concessions*
Wage differential for urban formal workers (percentage change from base level)				
Cotton yarn	0.00	7.23	−1.42	−9.48
Paper	0.00	−2.43	−8.26	−13.59
Leather	0.00	15.24	5.00	−4.71
Fertilizers	0.00	2.73	−8.68	−19.10
Cement	0.00	−4.67	−12.75	−20.37
Basic metals	0.00	−5.49	−16.40	−6.51
Metal products	0.00	−2.87	−10.66	−18.00
Petroleum	0.00	3.05	−4.65	−11.95
Electricity and gas	0.00	−3.99	−10.86	−16.97
Demand for urban formal labor (percentage change from base level)				
Cotton yarn	12.28	7.18	11.32	16.11
Paper	−5.11	−3.82	−1.04	1.96
Leather	30.82	15.53	22.27	30.43
Fertilizers	5.55	3.44	10.86	19.44
Cement	−11.31	−8.73	−4.32	0.63
Basic metals	−12.19	−9.70	−2.88	−10.83
Metal products	−7.64	−6.09	−1.90	2.99
Petroleum	4.43	2.36	6.50	11.21
Electricity and gas	−7.48	−5.71	−3.69	−1.57
Output (percentage change from base level)				
Cotton yarn	6.56	6.02	6.03	6.15
Paper	−0.76	−0.52	−0.03	0.50
Leather	32.75	28.47	29.21	30.36
Fertilizers	8.16	7.90	9.60	11.48
Cement	−7.71	−6.79	−5.27	−3.72
Basic metals	−6.70	−6.25	−5.30	−6.11
Metal products	−5.40	−4.69	−2.90	−1.02
Petroleum	7.77	7.12	8.59	10.17
Electricity and gas	−3.75	−3.53	−3.60	−3.60

Source: Authors' calculations.

When the active union makes wage concessions in conjunction with trade liberalization, jobs are saved in the unionized sector, but workers receive a lower wage. Consider the scenario with high concessions. The number of featherbedders declines dramatically (63.8 percent, see table 4), increasing the labor supply. The real return to urban formal workers declines 5.9 percent because of both loss of the union premium and increase in the supply of productive workers. The spillover effects favor the other labor groups. As output expands in response to the increase in the supply of urban formal workers (because of the reduction in featherbedders), the demand for other inputs increases as well. The real return to rural workers increases 6.5 percent, and the real return to urban informal workers increases 3.2 percent. Both are slightly better off than when there is trade liberalization with no unions.

To report the sensitivity of our results to the bargaining concessions, we consider the case in which the union makes low, rather than high, concessions. In this case, the pattern of wage change is the same, but the magnitude is smaller. Likewise, the number of featherbedders declines, but by a smaller amount (33.9 percent rather than 63.8 percent).

The sectoral effects of trade liberalization for the case with active unions and high concessions are more dramatic. The wage differential for cement and metal products declines 20.4 and 18.0 percent, respectively (table 5). The change in factor cost reverses the change in factor demand—there is an increase in the demand for urban formal workers in these sectors, compared with the decrease in demand in the model with no unions. However, the change in factor cost, coupled with the dramatic increase in productive labor as the number of featherbedders declines 63.8 percent (table 4), is not enough to reverse the change in output observed with trade liberalization. Output in cement, for example, declines 3.7 percent rather than 7.7 percent when there are no unions; likewise, output in metal products declines 1.0 percent rather than 5.4 percent.

Wage changes by sector reflect the loss of the union premium. For example, urban formal workers employed in the nonunion sectors experience a real wage increase of 2.3 percent (table 4). This real wage increase accrues to urban formal workers who do not change jobs. Those who change sectors may receive a different sectoral wage differential, changing the real wage received. However, those in the union sector experience a wage change that accounts for changes in the union premium, which declines in most unionized sectors. This decline in the wage premium means that the real average return to unionized labor declines 5.9 percent.

Given the structure of protection and intermediate demands, certain unionized sectors expand following trade liberalization (table 5). For example, leather production increases 32.8 percent following trade liberalization in a model with no unions. This reflects an increase in the demand for leather as an intermediate good in production. In the case with active unions and no bargaining concessions, the wage differential increases 15.2 percent because of the increase in

demand for leather as an intermediate good. This cost increase does dampen the increase in output, which rises only 28.5 percent in this case.

When high bargaining concessions accompany trade liberalization, the union premium declines for all sectors (table 5). In general, output increases (or does not decline as much) in this scenario, compared to the model with trade liberalization and no unions.

What does all of this imply for the benefits to be gained from trade liberalization in Bangladesh? The existence of active unions, which refuse to make bargaining concessions, does not seem to have much of an effect on welfare gains. Equivalent variation is 20.1 for the cases of trade liberalization both with exogenous price differentials and with active unions and no concessions (table 4). This result, different from that derived from the stylized model, is explained by the fact that some unionized sectors, such as leather, expand following trade liberalization. The wage differential in these sectors increases as well, offsetting the welfare gains that accrue when other unionized sectors contract.

In the more likely case that liberalization pushes the unions into making bargaining concessions, the gains from trade are higher. In this case the bigger fall in the union premium and the huge decline in the number of featherbedders more than offset any losses due to the unionization of export sectors.

III. Indonesia

In contrast to Bangladesh, Indonesia opted early on for less interventionist policies and an open trade regime, with excellent results. Real per capita GDP growth over the last fifteen years (1979–94) has averaged more than 4 percent a year. Exports of manufactured goods have been rising at more than 30 percent a year. Workers have reaped tremendous benefits from this growth. Formal sector jobs, which offer higher wages and greater job security, are being created at faster rates than ever before, much faster than in most other countries. Wage employment has been increasing at more than 4.5 percent a year, while real earnings have been rising at 9 to 10 percent a year.

Yet, in the 1990s labor unrest has increased. During 1989–92, the number of strikes rose thirteenfold from 19 to 251 and the number of working hours lost because of strikes rose from about 29,000 to more than 1 million. The fact that many of these strikes occurred in export-oriented enterprises close to Jakarta has drawn international and domestic public attention. Many observers, for example Agrawal (1995), attribute the spread of labor unrest to the failure of the officially sanctioned trade union movement to represent workers' rights and to negotiate better working conditions.

Indonesia is now under internal and external pressure to liberalize its labor regulations and ease restrictions on unions. Although Indonesian law clearly guarantees the right to form unions, difficulties arise in practice. There is only one legally recognized union in the private sector (the SPSI), which is closely linked to the government. Government decrees essentially prevent the forma-

tion of other independent unions that can represent workers in collective bargaining. Although workers can form worker organizations or company-level unions, only a registered union can bargain collectively with employers. The conditions for registration are very restrictive. As Freeman (1993) states in the context of other East Asian countries, "The seemingly innocuous procedure for registering trade unions is a powerful tool for repression."

Instead of liberalizing labor regulations, the government has tried to achieve industrial peace by increasing mandated benefits, especially minimum wages. What are the efficiency effects of mandating minimum wages compared with allowing unions greater independence?

Model Description

To answer this question, we consider the effect of a policy shock that reduces the demand for urban formal workers in Indonesia under three assumptions about the structure of the labor market: completely free labor markets where wage differentials are exogenous, labor markets where government sets a binding minimum wage, and labor markets where unions are allowed greater independence. We use Lewis's (1991) CGE model of Indonesia and modify the labor market structure. Because tariffs are quite low in Indonesia and do not protect sectors in which unions are likely to form, we choose a policy shock that is different from the one used in the Bangladesh model: a 20 percent reduction in government spending.

The Indonesia model has thirty sectors. We treat seventeen of the sectors that currently use formal labor relatively intensively as potentially unionized sectors to illustrate the rigidities that union behavior may introduce when there are economic reforms. These sectors account for 54 percent of the urban formal labor force. There are six factors of production: agricultural labor, rural labor, urban informal labor, urban formal labor, capital, and land. As in the Bangladesh model, all sectors use intermediate goods.

As we did in the case of Bangladesh, we compare the impact of an exogenous shock in a model with and without unions. In addition, we carry out simulations on a model with a minimum wage in order to see the impact of present policies. In the case with a minimum wage paid to urban formal workers, urban formal workers who become unemployed move into the urban informal sector, putting downward pressure on wages for workers in that sector. Unions, in contrast, provide high wages only for a portion of urban formal workers; urban formal workers who lose their job in a unionized sector remain in the urban formal labor market in another sector. Spillover effects to the other types of labor occur only through substitution in production.

Simulation Results

We consider a 20 percent decline in government spending. The purpose of the experiment is to change the composition of spending and therefore reduce the demand for commodities produced by unionized sectors. The government spends

about 85 percent of its income on services, which constitutes a unionized sector. With a 20 percent reduction in government spending, government savings and therefore total savings increase. Because savings equal investment, the increase in savings means an increase in investment spending. Some investment spending also increases the demand for output of the unionized sectors, but the net effect is a decline in demand for urban formal workers.

In the case with exogenous wage differentials (no unions), the real average wage for urban formal workers declines 3.1 percent (see table 6) because the government purchases services, a good that uses urban formal labor intensively. The share of value added accruing to urban formal workers in the service sector is 33 percent (see table 7). The real average wage decline is caused by both a decline in the demand for urban formal labor and the movement of these work-

Table 6. *Macroeconomic Effects of a 20 Percent Reduction in Government Spending in Indonesia under Alternative Specifications of the Labor Market*

Item	*Exogenous wage differential (no unions)*	*Minimum wage*[a]	*Active union*	*Passive union* $\mu = 0.35$	*Passive union* $\mu = 0.8$
Real market-clearing factor return (percentage change from base level)					
Agricultural labor	−0.67	−0.57	−0.76	−0.72	−0.80
Rural	0.27	0.22	0.30	0.25	0.24
Urban informal	0.40	−3.28	0.45	0.36	0.32
Urban formal	−2.84	0.00	−2.40	−2.02	0.07
Capital	0.00	0.00	0.00	0.00	0.00
Real average factor return (percentage change from base level)					
Agricultural labor	−0.59	−0.49	−0.67	−0.63	−0.71
Rural	−0.14	−0.12	−0.19	−0.18	−0.20
Urban informal	1.90	−1.42	1.93	1.88	1.90
Urban formal	−3.10	0.66	−3.33	−3.16	−3.27
Capital	0.49	0.45	0.48	0.47	0.48
Featherbedders	0.00	0.00	−2.41	0.00	0.00
Total exports	0.07	0.01	0.02	0.01	−0.06
Total imports	0.28	0.31	0.23	0.21	0.14
Unemployment (share of urban formal labor supply)	0.00	0.05	0.00	0.00	0.00
Equivalent variation[b]	38.1	23.15	38.01	38.92	44.60

a. There is comparable labor coverage—the number of urban formal workers affected by the policy shock—in the minimum wage and the various union scenarios.

b. Measured in units of the numeraire good. Equivalent variation is a weighted average over households, and a positive number indicates a welfare gain.

Source: Authors' calculations.

Table 7. *The Structure of Indonesia's Economy for Selected Sectors*

Sector	*Tariff*	*Share of output*	*Share of urban formal employment by sector*	*Share of sectoral value added paid to urban formal workers*
Chemicals	0.04	0.02	0.01	0.12
Machines	0.06	0.04	0.01	0.08
Construction	0.00	0.12	0.01	0.05
Trade	0.00	0.09	0.42	0.31
Transportation	0.00	0.05	0.02	0.08
Services	0.00	0.17	0.50	0.33

Source: Authors' calculations.

ers out of sectors that pay them a high wage differential. The real return to urban informal workers increases 1.9 percent (table 6).

In contrast, in the case with a minimum wage for urban formal workers, producers respond to the decline in demand by shedding labor. These workers move into the urban informal labor market where the real average wage declines 1.4 percent (table 6). The real average return to urban formal workers increases slightly, reflecting sectoral changes among them.

The presence of an active union forces the adjustment on urban formal rather than informal workers. Furthermore, the adjustment costs have more impact on unionized urban formal workers who lose their wage markup. The nonunionized urban formal workers who do not change sectors, in fact, are slightly better off because the wages paid to urban formal workers in nonunion sectors decline 2.4 percent rather than 2.8 percent in the case of exogenous wage differentials (table 6). The real return to urban formal workers, accounting for the decline in the wage premium and the reallocation of labor to sectors that pay different wage differentials, declines 3.3 percent in the case with active unions compared with 3.1 percent in the case with exogenous wage differentials. The larger decline in the case with active unions is caused by the loss of the union premium. Both demand and supply changes in the labor market affect the wage for urban formal workers. The labor supply increases because the number of featherbedders declines 2.4 percent. However, the demand for labor increases as the union wage premium decreases in certain sectors, such as services, which employs a large share of urban formal labor. The labor demand shift dominates, and the market-clearing wage declines less than in the model with exogenous wage differentials.

In the case with passive unions in Indonesia, the adjustment is also forced on urban formal workers whose real average return declines 3.2 percent when the union puts a low weight on wages and 3.3 percent when it puts a high weight on wages (table 6). The real average return to urban informal workers increases 1.9 percent for either specification of preferences. In all union sectors there is a positive relationship between the demand for urban formal labor and the wage differential (see table 8). When the union places a low weight on wages, the

results are quite similar to those in the model with exogenous wage differentials. When the union places a high weight on wages, there is a bigger change in the wage premium and a smaller change in employment, compared with the low-weight case. As a result, output generally declines more or increases less than when the union puts a low weight on wages.

Construction, a sector that expands as investment demand increases, illustrates the effect that different union preferences have on wages. When the union cares about wages—the high-weight case—the wage differential increases 11.3 percent as the sector expands (table 8). In contrast, when the union cares about employment—the low-weight case—the wage differential only increases 0.9 percent. Instead, employment increases 12.3 percent, as opposed to 1.1 percent in the high-weight case.

How do the different labor market specifications affect the welfare gains caused by the change in policy? The welfare gain is lowest in the case with a binding minimum wage, which has an equivalent variation of 23.2 (table 6). This reflects the fact that the binding minimum wage prevents the down-

Table 8. *Selected Sectoral Effects of a 20 Percent Reduction in Government Spending in Indonesia under Alternative Specifications of the Labor Market*

Sector	*Exogenous wage differential (no unions)*	*Minimum wage*[a]	*Active union*	*Passive union* $\mu = 0.35$	*Passive union* $\mu = 0.8$
Wage differential (percentage change from base level)					
Chemicals	0.00	0.00	1.26	0.16	−0.60
Machines	0.00	0.00	5.33	2.73	6.32
Construction	0.00	0.00	8.07	0.88	11.30
Transportation	0.00	0.00	1.19	0.55	−0.28
Services	0.00	0.00	−1.91	−2.01	−6.55
Demand for urban formal workers (percentage change from base level)					
Chemicals	2.08	−0.49	0.57	1.19	−0.07
Machines	9.47	6.44	4.35	6.13	1.06
Construction	13.97	10.48	6.39	12.26	1.14
Transportation	2.39	−0.39	0.87	1.11	−0.05
Services	−4.36	−6.52	−3.27	−3.49	−1.47
Output (percentage change from base level)					
Chemicals	−0.28	−0.19	−0.39	−0.35	−0.50
Machines	3.54	3.59	3.43	3.42	3.18
Construction	7.27	7.27	7.39	7.22	7.07
Transportation	0.06	0.26	−0.04	0.00	−0.04
Services	−4.07	−4.39	−3.87	−3.90	−3.50

a. There is comparable labor coverage—the number of urban formal workers affected by the policy shock—in the minimum wage and the various union scenarios.

Source: Authors' calculations.

ward adjustment in formal wages needed for an efficient reallocation of labor. In contrast, the equivalent variation under the various union specifications, which do allow flexibility in the economy, are all higher, ranging from 38.1 to 44.6. The union effects, compared with the exogenous wage differentials, follow the same pattern as in Bangladesh. In the case with active unions, the welfare analysis is the same as the no-union case because some unionized sectors expand, offsetting the gains as other unionized sectors contract. The case with passive unions and a high weight on wages has the largest welfare gain because the wage differential for services decreases the most. Note that the increase in the wage differential for construction as investment spending increases is dominated by the decline in services as government spending declines.

IV. Conclusions

In this article, we have evaluated the difference that the presence of labor unions has made to the outcome of economic reform in developing countries. Using a stylized, two-sector model, we have shown that the welfare gains from trade liberalization are amplified when there are unions in the protected sector. The reason is that increased import competition drives down the wage premium that unions enjoy, leading to a more efficient allocation of labor in the economy. Although this is true for both passive and active unions, the effect is much greater for active unions. Trade reform reduces the active unions' ability to protect featherbedders, yielding an additional gain as these surplus workers are absorbed into the productive labor force. Finally, if the threat of import competition prompts active unions to shed featherbedders as part of a contract with management, the welfare gains are astonishingly high.

We have applied the insights from this stylized analysis to two contemporary policy issues. In Bangladesh, where unions are strong, we have shown that further liberalization of international trade would produce a "double dividend"—greater efficiency in both labor and product markets. In Indonesia, where there are restrictions on union operations but trade has been substantially liberalized, we have shown that allowing unions greater freedom is superior to the current minimum-wage policy. This is because the wage markup of unions is still flexible in the face of adverse demand shocks, whereas a minimum wage introduces an additional rigidity in the economy. Unions are also preferable on equity grounds. In the case with a minimum wage, urban informal labor bears the cost of the adjustment. In the case with a union, however, urban formal labor bears the cost of adjustment.

Our work raises a host of political-economy issues that warrant further research. In a country like Bangladesh, unions will probably try to block reforms, such as trade liberalization, which make product markets more competitive. Governments in Indonesia or other East Asian countries may be reluctant to forgo regulation in favor of allowing more freedom to trade unions, which are

often opposed to the regime in power. How to convince vested interests to support globally beneficial policies is perhaps the central question facing developing countries today.

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Does the Type of Political Regime Matter for Trade and Labor Market Policies?

Arup Banerji and Hafez Ghanem

This article uses cross-country data to examine the link between a country's type of political regime and its degree of openness and labor market distortion. The analysis indicates that more authoritarian regimes are associated with higher trade protection and greater labor market distortions. This supports the view that political authoritarianism may be counterproductive to development in important respects.

The link between the political system of a country and its economic growth has attracted a great deal of attention in recent years (for an extensive survey of the literature see Alesina and Perotti 1994). Empirical studies have yielded mixed results, and a survey of the literature by Przeworski and Limongi (1993) concluded that they did not know whether democracy fosters or hinders economic growth. Authors from Friedman (1962) to Scully (1988) have argued that politically open societies grow at faster rates than societies where freedom is restricted. Others such as Kormendi and Meguire (1985) have found a negative relationship between civil liberty and growth, and Barro (1994) has argued that more political freedom may encourage a greater role for interest groups in the legislative process, thereby retarding growth. Landell-Mills and Serageldin (1992) summarize this literature by concluding that benevolent dictators are rare and that democracies often resort to populist policies that are inimical to growth.

The focus of this article is more narrow. We consider labor policies and, to the extent that they influence labor policies, policies affecting the openness of the economy. What, if any, is the link between such policies and the nature of the political regime? Many governments in developing countries have adopted labor policies—including high minimum wages, public sector overemployment, and job security guarantees—that benefit a small group of "insiders." But these same policies limit the opportunities of "outsiders," thereby aggravating income inequality, generating efficiency losses, and possibly discouraging investment and growth. Other countries in the developing world have resisted the tempta-

Arup Banerji and Hafez Ghanem are with the Europe and Central Asia IV Department of the World Bank. This article was originally prepared as a background paper for *World Development Report 1995: Workers in an Integrating World*. The authors thank Claudio Montenegro for research assistance and help. They also thank Joseph Ryan of Freedom House for providing data on political and civil liberties and Michael Walton, Alejandra Cox Edwards, Ishac Diwan, David Lindauer, Ana Revenga, Michal Rutkowski, John Sheahan, and three anonymous referees for their comments on an earlier draft.

tion to distort the labor market. Because labor policies are usually chosen for political rather than economic reasons, one would expect the nature of a country's political system and its degree of civil liberties to influence its choice of labor policies.

Does the type of regime really matter? We use data for ninety developing countries to shed light on this question. The article is divided into five sections. Section I discusses possible links between political structure and labor policies. Section II describes a simple political economy model similar to that of Grossman and Helpman (1994), but with a more elaborate labor market. The underlying analytical model is presented in the appendix. Section III discusses data chosen for variables in our estimating equations. Section IV presents results of empirical tests on cross-sectional data and section V summarizes our results.

I. Political Systems and Labor Policies

The existing literature linking economic growth to political regimes mostly avoids an exact definition of "democratic" and "authoritarian." This is understandable, considering the range of political systems existing in the world today. Although we realize that authoritarianism and democracy exist in a continuum, our understanding of the terms is closest to that of Przeworski (1991). He notes that, "Authoritarian regimes abhor *independent* organizations; they either incorporate them under centralized control or repress them by force" (p. 55, emphasis added). His definition of democracy is pithier: "Democracy is a system in which parties lose elections" (p. 10), but he goes on to say that the key feature of democracies is that they are populated by collective organizations (p. 12). Less authoritarian (and thus more democratic) societies allow independent organizations to participate more freely in the political process. At one extreme, only relatively harmless organizations may be allowed to associate freely—Przeworski gives the examples of stamp collectors societies—but only the most democratic regimes allow a free press, free trade unions, and truly contesting political parties.

There are two opinions about whether efficient labor market policies—defined as market-determined wages and employment levels—are more or less likely to occur under more authoritarian regimes. Country examples provide apparent support for both views. One view is that labor repression, which is only possible under authoritarianism, offsets the rent-seeking behavior of potentially powerful trade unions. According to this notion, freer societies are susceptible to inflated insider wages, strikes, and other forms of industrial unrest and consequently are susceptible to lower investment, less employment, and slower rates of growth. In this view high levels of civil liberty permit trade unions to agitate for above-market rents. With contestable elections, unions are likely to be granted these rents to nullify their political opposition. Hence supporters of this view conclude that authoritarian societies, which are better able to discourage the rent-seeking activities of free unions, are more compatible with labor market efficiency.

Examples from Chile, the Republic of Korea, Singapore, and Turkey in the 1970s and early 1980s support this view. At various times during these two decades, authoritarian regimes repressed trade unions and denied basic rights to workers. And, during the years of repression, Korea, Singapore, and Turkey experienced spectacular growth in the manufacturing sector and an increasing demand for labor. Rising profitability and labor demand in manufacturing increased the welfare of workers as a whole. Although similar results were not immediately apparent during Chile's authoritarian phase, many observers believe that labor reforms undertaken during authoritarian rule aided the strong resurgence of the Chilean economy in the 1990s.

Examples of democracies that adopted counterproductive labor market policies lend further credence to this argument. In India, long considered to be one of the few stable democracies in the developing world, labor market distortions have been common. For example, highly unionized coal miners in Bihar, one of India's most populous and politically important states, enjoyed large jumps in real wages in the years before national elections from 1972 to 1985 (Banerji and Sabot 1994). Over the years, democracies as diverse as Trinidad and Tobago, Sri Lanka, and Senegal have awarded large economic rents to their unionized employees.

The contrasting view is that the probability of governments passing inefficient labor legislation to benefit insiders is higher under authoritarian than under democratic regimes. Authoritarian regimes are often subordinate to special interests that let them hold on to power (Ames 1987). Lacking the broader base of more democratic governments, such regimes may use labor policies to acquire support from powerful groups including the urban labor elite. An important difference between democratic and authoritarian regimes is the degree of outsider influence. In a well-functioning democracy outsiders vote and impose some limits on what narrower interest groups can achieve. In a dictatorship the government need only worry about those groups that wield direct power. Because power is less evenly distributed than votes in this view, one should expect insider groups to have a greater say in dictatorships.

Support for this view comes from the fact that labor market distortions persist in many countries that are not democratic. For instance, the authoritarian government of General Velasco in Peru introduced numerous inefficient labor laws. The legacy of these laws continued into the 1980s, when no workers could be dismissed or even made to retire (Sheahan 1987). Sub-Saharan Africa provides many examples. Overstaffing in the public sector, high minimum wages, and restrictions on firing—policies introduced in the Congo, Kenya, Sudan, Tanzania, and Zambia in the 1960s—were typical of postindependence authoritarian African governments that needed to placate urban populations to avoid political unrest, but did not have to worry about millions of poor, informal, and rural workers. The phenomenon of authoritarian regimes succumbing to interest group pressure is not limited to Sub-Saharan Africa. In Egypt in the 1950s and 1960s, President Nasser, needing the support of the urban middle class,

guaranteed all college graduates a public sector job. In Bangladesh in the 1980s, General Ershad needed to neutralize the labor elite represented by SKOP, an organization of trade unions. He negotiated with SKOP and agreed to increase public sector wages and double severance pay, allowances, and nonwage benefits.

Although there are numerous democratic industrial countries with efficient labor markets, there are few long-lived democracies with efficient labor policies in the developing world. A few examples do stand out, such as Botswana and Mauritius—countries that combine relatively free polities with less distorted labor market policies. Also, countries that have made the transition from authoritarianism to democracy recently have been more likely to avoid adverse labor policies. For example, the new government in Chile moved to democracy and trade union freedom without increasing the rents for insiders. The end of repression in Korea in 1987 was initially associated with very contentious industrial relations. However, since 1990, collective bargaining has become an established institutional arrangement, with no negative impact on the functioning of the labor market or wage competitiveness.

The paucity of examples of countries with free political systems and efficient labor markets may merely reflect the fact that political freedom is a relatively new phenomenon in the developing world. However, as more developing countries adopt more participatory political systems, the question of whether such systems will improve or worsen the operation of their labor markets becomes even more pertinent.

II. Analytical Framework

We use a simple analytical framework to develop empirical tests to see which of these two views gets more support from available cross-country data. The framework is based on a static two-sector political economy model similar to that of Grossman and Helpman (1994), but with a more detailed specification of the labor market. An abbreviated version of the model is presented in the appendix. It describes a developing economy with two sectors—an urban, formal, manufacturing sector and a rural, informal, agricultural sector. Labor market distortions, like a minimum wage, are usually introduced to benefit formal sector workers, because informal sector workers are not covered by any labor legislation.

Formal sector workers and owners attempt to sway the government to enact policies favorable to them. Workers want higher minimum wages, and capitalists want higher profits. Therefore, both groups try to limit the degree of openness of the economy. While in a closed economy, above-market minimum wages and above-normal profits can be passed on as higher prices to domestic consumers, this becomes less easy when consumers are free to buy imported substitutes. Rents in the economy are created through protection and then are divided between formal sector workers and capitalists, although sometimes the government itself takes a share of the rent.

Although government policies may be influenced by dispassionate concerns about societal welfare, the government also undertakes actions aimed at maintaining its hold on power.[1] Rulers could have several reasons for wanting to remain in power, one being to continue appropriating "economic rent." The size of the rent the government wants to expropriate varies—the more venal a government, the more it extracts resources (which are "directly unproductive," the term coined by Jagdish Bhagwati) from the economy.[2]

The government has to take several factors into account in this sort of a political economy framework. First, it has to decide on its degree of venality—that is, how many resources it wants to seize. This would, in a more complete model than that presented in the appendix, depend on two factors: how much it cares about investment and future growth of the economy and how strongly it believes this venality will affect its chances to continue governing. Second, the government needs to estimate how support from each pressure group will improve its chances of staying in power. In a way, it has to weigh the importance of each group in the political process. For example, in a country where formal labor is fragmented and politically powerless, only capitalists have a voice in the political process. The reverse may be true in societies where organized labor is a key to mobilizing votes.

How could the type of regime matter? First, it could affect the government's level of venality. If authoritarian regimes tend to be more (or less) corrupt than democratic ones, they will create more (or less) rent through protection, some of which the government will appropriate. Second, the type of regime could affect the influence of different interest groups. If authoritarian regimes tend to be more (or less) subordinate to special interests, including formal sector labor, then they will generate more (less) rent through protection and give part of it to the special interests.[3]

This implies that policies are influenced by political factors (including the nature of the regime and the weight it attaches to labor and capitalist groups) as well as economic factors (wages, prices, and the structure of production and consumption). From this discussion and the formal model in the appendix, we derive two reduced-form equations for the level of protection of the domestic economy and the amount of wage distortions:

$$\tau = f(e, l, k, R) \tag{1}$$

$$\omega = f_1(\tau, e, l, k, R). \tag{2}$$

1. For another example of this type of analysis, see Hettich and Winer (1988). They develop the essential elements of tax systems as the outcome of rational behavior in a model where government maximizes expected support.

2. Lal (1984) argues, for example, that successive empires in Northern India's past were extremely venal. For a theoretical discussion of directly unproductive, profit-seeking (DUP) activities, see Bhagwati, Brecher, and Srinivasan (1984).

3. Subordinate here is used in the sense of Rodrik (1992).

The level of protection (τ) depends on economic parameters (e), the relative political importance of urban workers and capitalists (l and k, respectively), and the nature of the regime (R). The wage distortion (ω) is a function of τ as well as e, l, k, and R. In the case of a small economy, the economic parameters that we can expect to influence τ and ω include the price elasticities of consumption and production, the wage elasticity of the demand for labor, and the international price of the industrial good. (See the appendix.)

A priori, we expect τ to be increasing in l and k. As interest groups become more powerful, there will be more pressure to generate protectionist rents. The impact of R, the degree of political authoritarianism, on τ depends on which view about the effect of democratization on protectionism proves to be correct. We expect the wage distortion to be increasing in τ and l and to be decreasing in k. As more rent is available through trade protection, more could be given to urban workers. As the importance of urban labor as an interest group rises, urban workers will be able to get a larger share of the available rent, but an increase in the political importance of capitalists will lower the share of rents going to labor in the formal sector. As described in the previous section, the relationship between ω and R is the subject of debate and the focus of our empirical tests.

III. Estimating Equations and Data

We estimated equations 1 and 2, using cross-sectional data for ninety developing countries, to test whether the type of regime influences the level of trade protection and wage distortion. Our first task was to find consistent cross-country data. Because some data were missing for some countries, the actual number of observations varied from one regression to the other depending on the availability of the variables included in the regression.

For a measure of trade distortion, τ, we started by using the work of Dollar (1992), who estimates a measure of an economy's openness to trade for a large number of countries. This index—which we refer to as DOLLAR—rises as the level of protection increases. Because this index is available only for 1990, our analysis using DOLLAR was limited to cross-sectional work for that year. However, DOLLAR, like other measures of trade distortion, has shortcomings. Pritchett (1991) shows that alternative measures of trade distortion produce very different country rankings and argues that the probability of deriving a single measure that produces a correct ranking of countries is very low. (Also see Leamer 1988 and Harrison 1994.) We did not attempt to find such a measure, but we did experiment using alternatives to DOLLAR to check the robustness of our conclusions. Three alternatives were used: the mean frequency of nontariff barriers on manufacturing goods (MNTB), the mean of total import charges on manufacturing goods (TARIFF), and the black market premium (BMP).

Table 1 shows the correlation coefficients between different measures of trade distortion. They were not highly correlated, with correlation coefficients rang-

Table 1. *Correlation Coefficients between Different Indexes of Trade Distortion*

Index	DOLLAR[a]	*Mean frequency of nontariff barriers on manufactured goods,* MNTB	*Mean total import charges on manufactured goods,* TARIFF	*Black market premium,* BMP
DOLLAR[a]	1.00			
Mean frequency of nontariff barriers on manufactured goods, MNTB	0.08	1.00		
Mean total import charges on manufactured goods, TARIFF	−0.21	0.23	1.00	
Black market premium, BMP	0.21	0.37	0.08	1.00

a. An index measuring an economy's openness to trade for a large number of countries (see Dollar 1992).

Source: Authors' calculations.

ing from a high of 0.37 for MNTB and BMP to a low of −0.21 for the DOLLAR index and TARIFF.

The difficulty of choosing a single measure of trade distortion is further demonstrated by table 2, which shows the rankings of the average of each measure of trade distortion for seven regions of low- and middle-income countries. No two measures identified the same region as most trade distorted (1) or most open (7), and South Asia was ranked as most distorted by one measure (TARIFF) *and* most open by another (DOLLAR).

We relied on DOLLAR as our primary measure and used the others for sensitivity analysis, because DOLLAR provided the largest number of consistent cross-country observations for a recent year, 1990. We could not use some appealing measures of openness—like the one developed by Leamer (1988)—because of the small number of observations for low- and middle-income countries.

Measuring labor market distortions and the degree of protection to insiders was also a difficult empirical task. Ideally, we would have liked to use the ratio of formal to informal or rural wages, adjusting it for different worker characteristics. Once again, however, the data were not available for a large number of countries. Hence, we used as the numerator the average wage of an unskilled worker in manufacturing (obtained from ILO 1991), assuming that unskilled workers have characteristics resembling those of informal workers. Finding a suitable denominator was more problematic, because informal sector wage rates are not available for many countries. Instead, we had to use nonmanufacturing gross domestic product (GDP) per worker as a proxy for the informal wage rate. Thus, our wage distortion index (IDX) is simply the ratio of the manufacturing

Table 2. *Rankings of Degree of Trade Distortion in Seven Regions by Four Indexes*

Index	*East Africa*	*East Asia*	*Europe and Central Asia*	*Latin America*	*Middle East and North Africa*	*South Asia*	*West Africa*
DOLLAR[a]	2	6	5	4	3	7	1
Mean frequency of nontariff barriers on manufactured goods, MNTB	1	6	2	7	5	3	4
Mean total import charges on manufactured goods, TARIFF	4	7	5	2	6	1	3
Black market premium, BMP	4	6	7	5	1	2	3

Note: Rankings are from most distorted (1) to most open (7) and are based on the mean value of each index for each region. Indexes are defined in table 1.

a. An index measuring an economy's openness to trade for a large number of countries (see Dollar 1992).

Source: Dollar (1992) and Pritchett (1991).

wage rate to the nonmanufacturing value added per worker (calculated from World Bank 1993). An increase of this index was taken to imply greater distortions and more privileges for insiders.

For sensitivity analysis we used the proportion of workers in wage employment (PWE) as a second measure of labor market distortion (also from World Bank 1993). We expected PWE to be negatively related to wage distortion, because higher formal wages lead to a decline in output and employment in that sector, pushing more workers into agriculture and other informal activities. We used PWE rather than IDX as the dependent variable to test the robustness of our conclusions.

Table 3 ranks the same seven regions according to our two measures of labor market distortion. The region with the highest mean value of IDX received the ranking of 1, the second highest, 2, and so on. Whereas the region with the lowest mean value of PWE received the ranking of 1, the second lowest, 2, and so on. As can be seen from table 3, the two measures of labor market distortion yielded almost identical rankings for the seven regions.

Regarding economic parameters, in the discussion of the structural equation, we specified three elasticities—the price elasticity of consumption, the price elasticity of production, and the wage elasticity of labor demand—as possible sources of intercountry variance in distortions. Reliable data on these elasticities are not available for most countries, particularly developing countries.

As countries develop, the mix of goods produced and consumed changes also, as do the corresponding average elasticities. This product mix would depend not

just on the income level of a country but also critically on the human capital stock of the labor force (and, perhaps, of the consumers). Therefore, we thought it reasonable to use GDP per capita and the level of schooling as proxies for the economic factors in our structural equations. Both of these variables should be positively related to each of the three elasticities. This would hold under the assumptions that richer developing countries that have a higher stock of human capital are more likely (i) to consume proportionately fewer goods that are necessities and (ii) to have more diversity of production and access to nonlabor factors of production. If richer countries consume a higher proportion of luxury goods than do their poorer peers, increased GDP per capita would be associated with a higher economywide price elasticity of consumption. Although the relationship with schooling is not as intuitive, there is nothing to suggest that more educated consumers would prefer more goods that are necessities. A more diverse and flexible production process should, certainly, be associated with a workforce that is relatively better off and more educated. Richer countries should also, in general, have greater access to capital, technology, and other factors of production (including, of course, skilled labor as opposed to unskilled labor, whose wages were used here as data). Once again, the price elasticity of production should be positively associated with both GDP per capita and schooling. The same arguments would hold for the wage elasticity of labor demand.

We used the secondary school enrollment rate as our measure of the level of schooling. This is because primary school enrollment rates show very little variability across countries, except for some African economies. We did, however, run our regressions using the primary enrollment rate, as a test of robustness, and our conclusions remained unchanged.

We obtained measures of political structure from various sources. For a measure of the relative importance of urban, formal labor, we used the rate of urbanization. Ideally, we would have liked to use a measure of labor organization, such as the degree of unionization, but the availability of these data for enough countries and their comparability across countries are serious problems. To test

Table 3. *Rankings of Degree of Labor Market Distortion in Seven Regions by Two Indexes*

Index	*East Africa*	*East Asia*	*Europe and Central Asia*	*Latin America*	*Middle East and North Africa*	*South Asia*	*West Africa*
Wage distortion index, IDX[a]	2	4	7	5	6	3	1
Proportion of workers in wage employment, PWE	3	4	7	5	6	2	1

Note: Rankings are from most distorted (1) to least distorted (7) and are based on the mean value of each index for each region.

a. The ratio of the manufacturing wage rate to the nonmanufacturing value added per worker.

Source: Authors' calculations, from ILO (1991) and World Bank (1993).

for robustness, we also used the proportion of nonpoor urban workers in the population as a proxy for the political importance of formal labor. As a measure of the importance of capital owners, we used the income share of the top fifth of the population, recognizing that this is not an ideal measure. We also wanted to add to equations 1 and 2 a variable that would represent the size of government and the amount of resources it is able to extract from the economy. (The need for a tax measure as an explanatory variable is made clear by the model in the appendix.) The ratio of tax to GDP, obtained from the International Monetary Fund (IMF) statistics, was a natural choice.

The type of regime was classified using the indexes for political rights and civil liberties compiled by Freedom House.[4] These indexes range from 1 to 7, with 1 indicating the most rights and liberties and 7 the least. As defined by Freedom House, "Political rights enable people to participate freely in the political process, [and] civil liberties are the freedoms to develop views, institutions, and personal autonomy apart from the state" (Ryan 1994, p. 671).

In practice, political and civil liberties go hand in hand. Figure 1 presents regional averages for the two indexes and shows the high positive correlation between them—for the year 1990, we calculated the correlation coefficient between the two indexes to be 0.92. In our regressions, we used the two indexes interchangeably, with very little difference in results.

On the basis of the preceding discussion, we estimated three equations. Equation 3 is derived from equation 1 and estimates trade distortions. Equation 4 is derived from equation 2 and estimates labor market distortions measured by IDX, while equation 5 is derived from equation 2 and estimates labor market distortions measured by PWE.

$$\text{DOLLAR} = \alpha_0 + \alpha_1 \text{ GDP per capita} + \alpha_2 \text{ urbanization} + \alpha_3 \text{ INSH} + \alpha_4 \text{ education} + \alpha_5 \text{ tax rate} + \alpha_6 \text{ POL} + u_1 \tag{3}$$

$$\text{IDX} = \beta_0 + \beta_1 \text{ GDP per capita} + \beta_2 \text{ urbanization} + \beta_3 \text{ INSH} + \beta_4 \text{ education} + \beta_5 \text{ tax rate} + \beta_6 \text{ POL} + \beta_7 \text{ DOLLAR} + u_2 \tag{4}$$

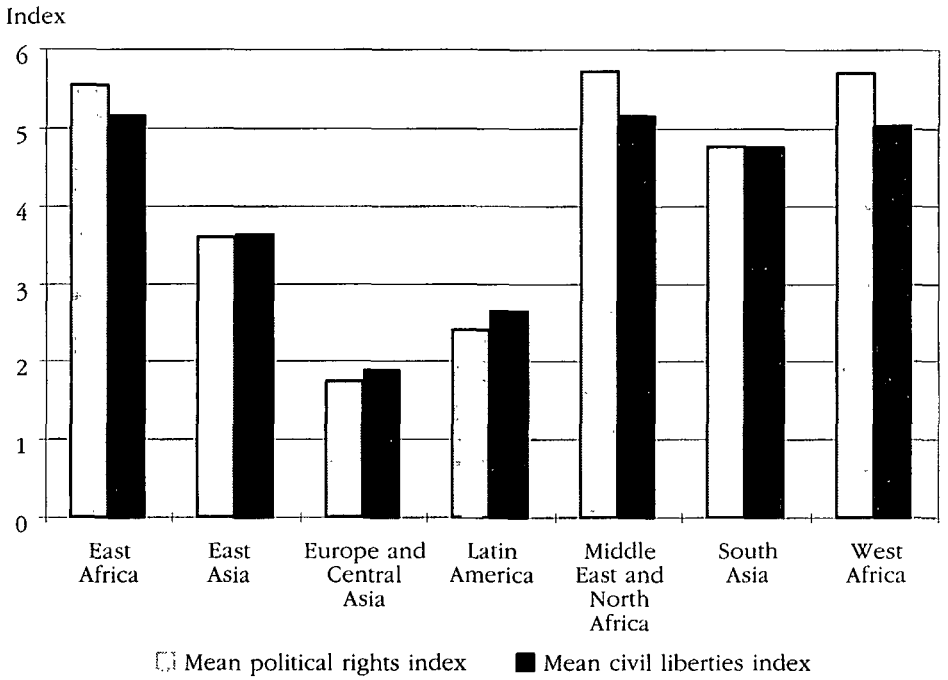
$$\text{PWE} = \delta_0 + \delta_1 \text{ GDP per capita} + \delta_2 \text{ urbanization} + \delta_3 \text{ INSH} + \delta_4 \text{ education} + \delta_5 \text{ tax rate} + \delta_6 \text{ POL} + \delta_7 \text{ DOLLAR} + u_3 \tag{5}$$

where INSH is the income share of the top fifth of the population, and POL denotes the index for political rights.

The test of our two competing hypotheses of whether democratic or authoritarian regimes are more prone to have distortionary labor policies consists of testing for the signs of α_6, β_6, β_7, δ_6, and δ_7. If democratic regimes are more likely to achieve more efficient labor market outcomes, α_6 and β_6 should be positive and δ_6 negative—that is, regimes with more political freedom tend to place fewer restrictions on trade, which in turn implies a smaller spread between formal and informal workers and a relatively larger proportion of the labor

4. This index is sometimes called the Gastil index, after its originator. However, the updated indexes are no longer compiled by Gastil, but by Freedom House.

Figure 1. *Measures of Political and Civil Liberties, by Region, 1990*



Note. Lower values for the indexes indicate higher levels of rights and liberties.
Source. Freedom House.

force in formal employment. Our analytical model predicts that under both hypotheses the sign of β_7 should be positive and δ_7 should be negative—that is, labor market distortions cannot persist if product markets are competitive.

Estimates of equations 3 to 5 can demonstrate whether there is a relationship between regime type and labor policy. However, they cannot shed light on why this is the case. Particularly, they do not show whether authoritarian or democratic regimes are more subordinate to organized labor.[5] To do so, we added an interaction term between the labor power and regime variables.

IV. Empirical Results

We started by estimating equation 3 to look at the relationship between type of regime and level of trade protection. The parameter estimates are presented in table 4. The coefficient on the political liberties index was positive and significant in nearly all the regressions we tried, indicating that countries with less political freedom tend to have trade regimes that are more closed. When we included the indexes for both political and civil liberties in the regression, the

5. We are grateful to an anonymous referee of this journal for pointing this out and suggesting a solution.

Table 4. *The Impact of Regime Type and Other Variables on the Level of Trade Protection*

Equation	*Constant*	*GDP per capita*	*Rate of urbanization*	*Education*[a]	*Ratio of tax to GDP*[b]	*Political rights index*[c]	*Income share of the top fifth of the population*	*Interaction term between labor power and regime variables*[d]	*Proportion of nonpoor urban workers*	*Civil liberties index*[e]	*Number of observations*	R^2
1	4.7	−0.0 *	1.6*	−1.3	104.2	17.5**	0.7	−0.3			43	0.27
	(0.1)	(−1.8)	(1.9)	(−0.8)	(1.1)	(2.1)	(0.8)	(−1.4)				
2	53.7	−0.0	0.6	−1.5	52.2	7.2	0.6				43	0.23
	(1.03)	(−1.4)	(1.2)	(−0.8)	(0.6)	(1.6)	(0.7)					
3	107**	−0.0	0.3		50.2	9.1*				−5.6	71	0.24
	(4.7)	(−0.6)	(1.0)		(0.76)	(1.8)				(−0.8)		
4	98.2**	−0.0	0.3	−2.7**	63.4	5.4**					71	0.24
	(5.0)	(−0.5)	(1.0)	(−2.3)	(1.0)	(2.16)						
5	90.3**	0.0		0.2	−2.4	7.9*			0.2		40	0.20
	(3.8)	(0.2)		(0.3)	(−0.0)	(1.9)			(0.3)			
6	111**	−0.0		−2.4**	40.2	5.1**					82	0.18
	(7.6)	(−0.1)		(−2.1)	(0.7)	(2.0)						
7	97**	−0.0			44.1	7.1**					82	0.18
	(8.2)	(−1.0)			(0.8)	(2.9)						
8	100**	−0.0				7.6**					90	0.18
	(8.2)	(−1.0)				(3.4)						
9	101**	−0.0								8.0**	90	0.14
	(6.8)	(−1.1)								(3.0)		
10	96.8**	−0.0	0.3	−2.7**	62.5	5.8**					71	0.24
	(4.8)	(−0.5)	(1.0)	(−2.3)	(1.0)	(2.1)						

Note: The dependent variable is the DOLLAR index of openness. An increase in the DOLLAR index implies greater restrictions on trade. The last equation was estimated using instrumental variables. Numbers in parentheses are t–statistics.

* Significant at the 10 percent level.

** Significant at the 5 percent level.

a. The secondary school enrollment rate.

b. Obtained from IMF statistics.

c. Compiled by Freedom House (1994).

d. Labor power is the proportion of nonpoor urban workers; the regime variables are the political indexes.

e. Compiled by Freedom House (1994), also called the Gastil index.

Source: Authors' calculations.

coefficient on the political index remained significant, although less than before, but the civil liberties index was insignificant. This result is not surprising, because the two indexes are so highly correlated. When we dropped the civil liberties index, the political index became much more significant, and when we dropped the political index, civil liberties became significant. But in most of the regressions we tried, the political index outperformed the civil liberties index.

We also tried to sort out possible two-way linkages. It has been argued that richer societies choose to be democratic (see, for example, Helliwell 1992). Because they also tend to be more open, the direction of causation may be from openness to the political regime and not, as is suggested by our analytical framework, the other way around. Therefore, we reestimated our equations using lagged values of the political index. The results, reported in the last row of table 4, did not change.

Of the two variables included for economic structure, only the level of education appeared significant, with countries that have a more educated labor force tending to be more open. Surprisingly, GDP per capita and the tax to GDP ratio appeared to be unrelated to openness.

Although our results indicate that more democratic countries tend to have more open economies, they do not support the view that this is related to the power of interest groups. The proxy for the importance of formal labor (urbanization) was marginally significant in only one equation, and the proxy for the importance of capitalists (the income share variable) was never significant. When we dropped the income share variable, the significance of urbanization did not improve. We also tried to interact the regime variable with the labor power variable, but the interaction term was not significant. Finally, we tried using the proportion of nonpoor urban workers as a proxy for labor power instead of urbanization, but the results were even worse. This could be because the number of urban workers is not a good proxy for labor influence. However, if it is a good proxy, the insignificance of the urbanization and interaction variable would indicate that, for our sample, labor power in the economy has no effect on the degree of openness, regardless of the type of regime.

The robustness of the relationship between openness and regime type was further tested by reestimating the equations presented in table 4 using MNTB, TARIFF, and BMP as dependent variables. The results for MNTB and BMP were quite similar to the ones obtained for the DOLLAR index, with the coefficient on the index for political rights being positive and significant. However, the use of TARIFF as a measure of openness changed our conclusion. The coefficient on the index for political rights in the TARIFF equation was insignificant and had a negative sign. Table 5 reports results for one form of equation 3 with MNTB, TARIFF, and BMP as dependent variables.

Estimates of the parameters of equation 4 are presented in table 6. As predicted by our analytical framework, there was a strong positive correlation between the DOLLAR index and the index of wage distortion. The index of political liberties became significant only when the DOLLAR index was dropped from the equation.

Table 5. *The Impact of Regime Type and Other Variables on Three Measures of Openness*

Dependent variable	*Constant*	*GDP per capita*	*Rate of urbanization*	*Education*[a]	*Ratio of tax to GDP*[b]	*Political rights index*[c]	*Number of observations*	R^2
Mean frequency of nontariff barriers on manufactured goods, MNTB	26.7 (1.2)	−0.00 (−0.5)	−0.04 −(0.13)	0.31 (0.22)	−46.4 (0.6)	8.0** (2.7)	48	0.24
Mean total import charges on manufactured goods, TARIFF	64.3 (4.2)	−0.00 (−1.1)	−0.02 (−0.1)	0.53 (0.5)	−94.4* (−1.8)	−2.6 (−1.20)	48	0.19
Black market premium, BMP	15.9 (0.14)	0.01 (0.4)	−0.05 (−0.0)	9.2 (1.4)	−1082** (−2.8)	47.7** (2.7)	67	0.23

Note: Numbers in parentheses are *t*-statistics.
* Significant at the 10 percent level.
** Significant at the 5 percent level.
a. The secondary school enrollment rate.
b. Obtained from IMF statistics.
c. Compiled by Freedom House (1994).
Source: Authors' calculations.

Table 6. *The Impact of Regime Type and Other Variables on the Index of Wage Distortion*

Equation	*Constant*	*GDP per capita*	*Rate of urbanization*	*Education*[a]	*Rate of tax to GDP*[b]	*Political rights index*[c]	*DOLLAR*[d]	*Income share of the top fifth of the population*	*Interaction term between labor power and regime variables*[e]	*Proportion of nonpoor urban workers*	*Number of observations*	R^2
1	3.3	0.0	0.0	−0.1	0.0	0.1	0.01 *	−0.1 **	−0.0		26	0.41
	(1.6)	(0.3)	(0.1)	(−1.2)	(0.0)	(0.4)	(1.7)	(−2.1)	(−0.2)			
2	3.5 **	0.0	−0.0	−0.6	−0.4	0.1	0.01**	−0.1**			26	0.41
	(2.5)	(0.4)	(−0.2)	(−1.2)	(−0.2)	(0.6)	(2.3)	(−2.3)				
3	3.1**	0.0		−0.04	−3.7	0.1	0.02**	−0.1**		−0.02	21	0.64
	(2.1)	(0.7)		(−0.8)	(−1.4)	(0.6)	(3.4)	(−2.8)		(−1.0)		
4	0.6	0.00	−0.02	−0.04	−2.3	0.1	0.02**				42	0.45
	(0.6)	(0.6)	(−1.4)	(−0.8)	(−0.8)	(0.7)	(3.0)					
5	0.9	0.00	−0.02	−0.04	−2.4		0.02**				42	0.44
	(1.0)	(0.5)	(−1.6)	(−0.8)	(−0.9)		(3.5)					
6	1.9**	0.00	−0.01	−0.1	0.4	0.21*					42	0.32
	(2.0)	(0.2)	(−0.8)	(−1.5)	(0.14)	(1.8)						
7	−0.4	−0.00					0.02**				48	0.26
	(−0.4)	(−1.4)					(3.3)					
8	0.65	−0.00				0.36**					50	0.21
	(0.95)	(−0.6)				(2.7)						
9	0.5	−0.0	−0.0	−0.0	−2.2	0.1	0.02**				42	0.45
	(0.5)	(−0.7)	(−1.4)	(−0.7)	(−0.8)	(1.0)	(2.8)					

Note: The dependent variable is the index of wage distortion. An increase in the index of wage distortion implies worse labor market policies. The last equation was estimated using instrumental variables. Numbers in parentheses are *t*- statistics.

* Significant at the 10 percent level.

** Significant at the 5 percent level.

a. The secondary school enrollment rate.

b. Obtained from IMF statistics.

c. Compiled by Freedom House (1994).

d. An index measuring an economy's openness to trade for a large number of countries (see Dollar 1992).

e. Labor power is the proportion of nonpoor urban workers; the regime variables are the political indexes.

Source: Authors' calculations.

Table 7. *The Impact of Regime Type and Other Variables on the Proportion of the Labor Force in Wage Employment*

Equation	*Constant*	*GDP per capita*	*Rate of urbanization*	*Education*[a]	*Rate of tax to GDP*[b]	*Political rights index*[c]	*DOLLAR*[d]	*Income share of the top fifth of the population*	*Interaction term between labor power and regime variables*[e]	*Proportion of nonpoor urban workers*	*Number of observations*	R^2
1	−30.3	−0.0	0.9**	0.3	96.4**	3.1	−0.1*	0.7*	−0.0		34	0.61
	(−1.3)	(−1.2)	(3.0)	(0.5)	(2.6)	(1.0)	(−1.8)	(1.9)	(−0.5)			
2	−24.6	−0.0	0.8**	0.3	90.2**	1.9	−0.1*	0.6*			34	0.70
	(−1.30)	(−1.1)	(4.2)	(0.5)	(2.7)	(1.6)	(1.7)	(1.9)				
3	−37.8*	−0.0*		0.5	62.8*	0.3	−0.1	1.2**		0.9**	30	0.71
	(−1.9)	(−1.7)		(0.8)	(2.0)	(0.2)	(−0.8)	(3.6)		(4.9)		
4	23.6**	−0.00	0.7**	0.2	74.2**	−0.4	−0.15**				50	0.65
	(2.1)	(−0.4)	(4.5)	(0.4)	(2.1)	(−0.3)	(−2.3)					
5	18.3*	−0.00	0.7**	0.2	72.6**		−0.15**				50	0.65
	(1.8)	(−0.4)	(4.6)	(0.4)	(2.1)		(−2.4)					
6	7.5	−0.0	0.6**	0.8	52.4	−1.0					53	0.63
	(0.8)	(−0.2)	(4.0)	(1.6)	(1.6)	(−0.8)						
7	48.0**	0.01**					−0.1				60	0.35
	(4.9)	(5.0)					(−1.4)					
8	50.2**	0.00**				−2.8**					67	0.37
	(7.7)	(5.2)				(−2.1)						
9	18.8*	−0.00	0.7**	0.2	73.3**	−0.2	−0.15**				50	0.65
	(1.7)	(−0.4)	(4.6)	(0.4)	(2.1)	(−0.1)	(−2.4)					

Note: The dependent variable is the proportion of the labor force in wage employment. An increase in the proportion of wage employment is taken as an indication of good labor policies. The last equation was estimated using instrumental variables. Numbers in parentheses are *t*-statistics.

* Significant at the 10 percent level.

** Significant at the 5 percent level.

a. The secondary school enrollment rate.

b. Obtained from IMF statistics.

c. Compiled by Freedom House (1994).

d. An index measuring an economy's openness to trade for a large number of countries (see Dollar 1992).

e. Labor power is the proportion of nonpoor urban workers; the regime variables are the political indexes.

Source: Authors' calculations.

Our results imply a strong link between authoritarianism and protectionist policies, and between protectionist policies and labor market distortions, but the direct link between political liberties and labor distortions seems less strong. This suggests that regime type may affect the labor market mainly through trade policies and that, for a given level of protection, the distribution of rents between different interest groups is little affected by the degree of political freedom.

Our results concerning the impact of lobbies and interest groups on labor market distortions were mixed. The coefficient on the income share variable was negative and statistically significant. This fits with the predictions of our analytical framework: capitalists will try to limit labor's share in the economic rents. However, the coefficients on the proxies for labor power (urbanization and the proportion of nonpoor urban workers) were never significant—either alone or when interacted with the political variable. Assuming that these are good proxies, the results suggest that, whatever the regime type, organized labor has little power to affect overall wage distortions in the economy. Both results are consistent with the anecdotal evidence presented in section II.

Remarkably, none of the economic structure variables appeared to have an impact on wage distortions. This contradicts the general impression that poorer countries tend to have more distorted labor markets.

We further tested the robustness of our results by estimating equation 5 (see table 7). The results supported our previous conclusion concerning the link between openness and labor policy. The parameter on the DOLLAR index was negative and significant in nearly all of the regressions we tried, indicating that more closed economies generally have relatively smaller formal labor markets. The parameter on political liberties was also negative, but significant only in equations where the DOLLAR index was dropped.

The proxies for labor power (urbanization and the proportion of nonpoor urban workers) entered those regressions with very significant positive coefficients, which is the opposite of what is predicted by the model and may simply reflect the fact that urbanization and the proportion of nonpoor urban workers are not predetermined with respect to the size of the formal sector. We tried to deal with this by using instrumental variables, with lagged values of the explanatory variables as instruments, but the results did not change (see the last row of table 7). The coefficient on the income share variable was positive and significant, as predicted by the model. This result could mean that in most countries employers' political power is more important than labor's power in determining the share of rents that go to labor. Or it may simply reflect the poor quality of the data for labor organization.

We also experimented with dropping some variables. The results of regressions where we dropped all explanatory variables except GDP per capita and the DOLLAR and political liberties indexes are also presented in table 7. In both cases GDP per capita had a positive and significant coefficient. The openness index had a negative coefficient, with a *t*-statistic that was just below the 10 percent critical value, and the political liberties index had a negative and significant coeffi-

cient. Countries with less political freedom apparently have relatively smaller formal labor markets, an indication of greater distortions.

We tried redoing the estimates in tables 6 and 7 using other measures of openness. The results were not as strong. Estimates with MNTB and BMP had the same sign as estimates with the DOLLAR index but were rarely statistically significant. This could be because we had fewer observations for MNTB and BMP than for DOLLAR or because MNTB and BMP are inferior to DOLLAR as measures of trade protection. Estimates using TARIFF were also insignificant but had the wrong sign—which could have been expected from the correlation coefficients presented in table 1. Thus, our general conclusion that countries with less liberty tend to have more barriers to trade and more labor market distortions is quite sensitive to the choice of openness measures.

V. Conclusions

Our work provides evidence that authoritarianism may be associated with higher trade protection and that trade restrictions, in turn, are associated with more labor market distortions. This conclusion fits the pattern observed in many countries in Sub-Saharan Africa, the Middle East, and Latin America in the 1970s and 1980s, where authoritarian governments provided producers with protection through tariffs and quotas and ensured that workers in favored industries obtained part of the rent through various labor market interventions. Those same governments often repressed labor in other sectors and only tolerated unions subordinate to the regime.

Landell-Mills and Serageldin (1992) argue that freedom of association is one of the elements of good governance that are necessary for development. Inasmuch as authoritarian regimes that did not respect freedom of association tended to be linked with policies restricting trade and distorting labor markets, our work supports this view. This is not to say that inequitable or inefficient labor policies are the exclusive domain of authoritarian governments or that authoritarianism automatically implies these policies. As we discussed in the introduction, there are numerous counter-examples. Our results, based on a large cross section of developing countries, also support the work of Fields (1994) and Freeman (1993) on East Asia, which argues that labor repression was neither necessary nor desirable for development.

Our findings are also consistent with empirical literature linking political democracy and economic growth. Works by Barro (1991), Ozler and Rodrik (1992), and others have found that having less civil liberty is strongly correlated with slower growth. And the case for openness stimulating growth is well known. Similarly, undesirable labor market policies may handicap economic growth by stifling the process of production and capital accumulation. Our conclusions associating authoritarianism with restrictive trade policies and labor market distortions suggest some specific mechanisms as well as provide further empirical evidence linking the lack of political freedom with slower rates of growth.

How is the relationship between authoritarianism and trade and labor policies mediated? Do authoritarian regimes tend to be more subordinate to special interests than regimes with more political and civil liberty? Data limitations have prevented us from responding adequately to those questions. Finding better proxies for the political power of labor and business groups and specifying equations that allow a deeper understanding of those links is a subject for future research.

Appendix. An Analytical Model of Lobbies, Trade, and Labor Policies

The influence of lobbying by organized labor and capitalist groups can be illustrated with the help of a simple, static, two-sector political economy model similar to that of Grossman and Helpman (1994) and Rama and Tabellini (1994). A more detailed exposition of the model can be found in Banerji and Ghanem (1995).

Structure of the Economy, Production, and Incomes

Assume that there are three groups in the economy, with the total population normalized to 1:

(A-1) $0 < l < 1$ urban manufacturing laborers

(A-2) $0 < k < 1$ capitalists

(A-3) $a = (1 - l - k)$ rural agricultural laborers.

The three groups are denoted by superscripts L, K, and A.

Each individual in the economy consumes two goods—an agricultural good x and a manufactured consumption good c. Individual utility maximization for individual i is given by:

(A-4) $$\text{Max } u^i = x^i + U(c^i)$$
$$\text{subject to } y^i = x^i + pc^i.$$

This gives us $c^i = c(p)$ for all consumers, where p is the domestic price of the manufacturing good, and y^i is income of individual i.

The agricultural good x is produced with labor only, at a wage normalized to 1: $x = f(a) = a$. With no loss of generality, migration from the agricultural to the manufacturing sector is assumed to be costless. Thus, urban workers have a floor wage of 1—the supply price of labor in the economy. In the manufacturing sector, quantity Q of the good c is produced with labor $L \leq l$, and capital K owned by capitalists: $Q = F(L, K)$. For tractability, K is assumed to be fixed.

The government sets tariff τ on imports of the manufactured good by setting the domestic price $p = (p^* + \tau)$, where p^* is the world price of the manufactured good. Tariff revenues T are redistributed evenly to every individual in the economy (following Grossman and Helpman 1994). Because the population is normal-

ized to 1, each individual receives an amount $T(p, w)$, where w denotes manufacturing wages, because imports can be shown to be a function only of prices and wages.

Capitalists also receive income through manufacturing sector profits. Profit maximization is on the basis of the domestic price p (which differs from the world price p^* by the amount of the tariff) and the prevailing manufacturing wage rate, w (which the government can influence through minimum wage and other legislation). Employed manufacturing workers receive w, while those left unemployed revert to the floor wage, 1.

Finally, employed manufacturing workers and capitalists are forced to pay a tax v to the government out of their incomes (this is explained in greater detail below). They also pay contributions (or bribes), denoted as b^j ($j = L, K$), to the government in an attempt to influence policy. The contribution from each of the two groups is a mapping with the prevailing policy parameters—the wage and the domestic price (affected by the tariff set by the government): $b^j = b^j(p, w)$. They each optimize their political contributions until the marginal effect of the contribution on policy equals the marginal increase in their own welfare from the same policy:

$$u_p^L = b_p^L; \quad u_w^L = b_w^L \tag{A-5}$$

$$u_p^K = b_p^K; \quad u_w^K = b_w^K. \tag{A-6}$$

Note the use of the stylized facts: rural/agricultural workers do not pay the income tax but do pay the tariff; however, they have no influence on the level of the tariff.

The Government

The government sets the policy parameters. Its objective may be not merely to act as a social planner that maximizes national welfare, but, in addition, to remain in power. This second purpose is motivated in our model by presuming that if the government is in power, it can extract rent from the formal sector's product—that is, it can charge the tax v on the incomes of employed labor and capitalists. For the time being, we assume that v is a given for the economy and measures a particular government's level of venality. The value $v = 0$ indicates a purely altruistic social planner, and $v = 1$ indicates a totally confiscatory regime.

We also assume that the probability of the government maintaining its power is affected by nonpolicy actions that the government may take—for example, launching an election campaign or maintaining a military. These actions are financed by the political contributions it receives from labor and capitalists (which can, of course, also be thought of as proxies for the degree of support these groups provide to the government).

The government thus maximizes its objective function Γ, where $\Gamma = W + V$, and

(A-7) $$W = k\,u^K(p, w) + l\,u^L(p, w) + a\,u^A(p, w)$$

(A-8) $$V = \pi(B)\,v[pQ(p, w)]$$

(A-9) $$B = s^L b^L(p, w) + s^K b^K(p, w).$$

W represents pure aggregate welfare of individuals in the economy. The term V, by contrast, captures the expected rents to a nonaltruistic government from staying in power. As discussed, the rents amount to a tax v on the value of manufacturing production. Note that when $v = 0$ (the government is nonvenal), $V = 0$ and thus $\Gamma = W$—the government only maximizes aggregate welfare.

π indicates the probability that the government will stay in power in order to enjoy the rents (in this static model, it may also be thought of as the number of years that the government believes it will be in power). This probability is assumed to increase with larger political contributions from urban groups, that is, $\pi'(B) > 0$, as the government is assured more tangible and intangible political support from the interest groups. However, for a given government, the contributions from labor and capitalists may not have equal value: their relative importance in the particular polity is measured by the variables, s^L and s^K, respectively, with $1 \geq s^L \geq 0$, and $s^K = 1 - s^L$. The term B, therefore, summarizes the subjective weight the government places on total political contributions.

The government maximizes Γ with respect to its policy parameters p and w. Simplifying the resulting simultaneous equation system, we get the government's optimal tariff and manufacturing wage premium in equilibrium:

(A-10) $$\frac{\tau}{p} = \left(\frac{Q/c}{\eta}\right)\left\{1 - \frac{(1-v)}{\sigma}[S^K + (\gamma + \lambda)(S^L - S^K)] - \frac{V}{\sigma p Q}[1 + \gamma(1 + Q)]\right\}$$

(A-11) $$\omega = \left(\frac{w-1}{w}\right) = \frac{1}{S^L}\left[\frac{\sigma}{(1-v)}\frac{\tau}{p} + \frac{V}{(1-v)p} + (1/\lambda)(S^L - S^K)\right]$$

where Q is the quantity produced of the manufacturing good, S^J measures the government's assessment of the likelihood of staying in power due to the political contribution of group J, σ indicates the corresponding weighted average of this likelihood, and $S^J = (V\rho / B)s^J$, $J = L, K$. Note that when $v = 0$, $S^J = 0$, that is, a nonvenal government is not concerned about the effect of interest groups on the likelihood of its remaining in power. We also define $\sigma = (1 + kS^K + lS^L)$ (when $v = 0$, $\sigma = 1$). Finally, we use some elasticity measures to simplify the equations: $\rho = B\pi'(B) / \pi$ measures the elasticity of the probability of remaining in power with respect to political contributions, $\gamma = pQ_p / Q$ is the price elasticity of production (that is, the supply elasticity) of the manufactured good, $\eta = pc_p/c$ is the price elasticity of consumption, and $\lambda = (wL_w)/L$ is the wage elasticity of labor demand in manufacturing.

These equations demonstrate a common feature of this class of models. The government makes its decision about the degree of openness in the economy independent of the decision about wages. Since Q and c are endogenous, the decision on the level of protection is a function of variables relating to the structure of the economy (η, γ, and λ) and political variables summarized by V, σ, and S.

This simple model also predicts that a government only interested in maximizing welfare, that is, one that is nonvenal, will set tariffs at the level of optimal tariffs. However, if staying in power and collecting rents are also in its objective function, it will impose higher tariffs and create a larger wedge between domestic and foreign prices. The size of the tariff will depend on the government's preferences, the power of interest groups, and economic factors (such as the price elasticity of imports) that determine the relationship between changes in tariffs and changes in revenue. Finally, the wage distortion depends directly on the trade regime.

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