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ECONOMIC REVIEW

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THE WORLD BANK ECONOMIC REVIEW

Patterns of Transition from Plan to Market

Martha de Melo, Cevdet Denizer, and Alan Gelb

The transition from a planned economy to a market economy involves a complex process of institutional, structural, and behavioral change. This article develops an index of economic liberalization and analyzes its interaction with growth and inflation, using data from twenty-six transition countries for 1989–94. The article reveals two paradoxes of transition. First, the attempt to maintain output by subsidizing enterprises results in larger declines in output than occur under a policy of reducing subsidies. Second, price liberalization results in lower inflation than occurs under a policy of continued price controls.

Strong common patterns exist among countries at similar stages of reform. The common legacy and the associated changes that result from initial disruptions in the socialist economic coordinating mechanisms and subsequent liberalization measures go a long way toward explaining the transition experience. Because strong interactions between liberalization and stabilization are likely, stabilization becomes a priority for the resumption of growth.

The transition from a planned economy to a market economy involves a complex process of institutional, structural, and behavioral change. Formerly socialist countries have moved along this transition to varying degrees.[1] In this article we look at these countries in comparative perspective, emphasizing the cornerstone of the early reforms—economic liberalization, for which we develop an index—and its interaction with growth and inflation. We set up a simple conceptual framework to help interpret these relationships and also consider patterns of economic activity, at the macroeconomic and sectoral levels, that underlie these interactions.

Our findings help to explain two paradoxes of transition. First, the attempt to maintain output by subsidizing enterprises results in larger declines in output than occur under a policy of reducing subsidies. Cuts in subsidies are possible only with economic liberalization, which at the same time facilitates reallocation of resources within the economy. Resources more easily shift away from activities for which there is low demand and toward activi-

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ties with growth potential. Second, price liberalization results in lower infla-
tion than occurs under a policy of continued price controls. This is because
controls cannot be maintained in the face of strong inflationary pressures
caused by large-scale subsidization on all the controlled sectors. Initial price
increases after markets are freed help to absorb excess liquidity in the
economy. And liberalization facilitates stabilization by enabling the reduc-
tion of fiscal and central bank subsidies.

Our analysis covers twenty-six countries, including ten in Central and East-
ern Europe, fifteen in the former Soviet republics, and Mongolia. The period
covers six years, from 1989 to 1994. The first of these years, 1989, is widely
regarded as the year before the initial postcommunist transitions, although Hun-
gary, Poland, and the former Yugoslavia had previously initiated significant
reforms.

In section I we present a conceptual framework of how liberalization affects
the economy during transition. We identify four stylized features of the socialist
legacy and predict corresponding changes for the transition. These changes are
stimulated by a wide range of policy reforms collectively referred to as "eco-
nomic liberalization," but a summary measure is needed to link liberalization to
macroeconomic performance. An important feature not mentioned is the wide-
spread availability of basic human services (education, health services, and hous-
ing) associated with a more equal distribution of income than is found in capi-
talist countries (Milanovic 1995). The transition has been accompanied by
increasing inequalities in money income and a deterioration in social services,
but these issues are beyond the scope of this article.

In section II we define a composite index that takes into account three
dimensions of liberalization: internal markets, external trade and payments,
and the facilitation of private sector entry. We rank countries according to
the depth of these policy reforms in each of the years from 1989 to 1994.
Country classification is then based on cumulative liberalization, reflecting
the duration as well as the depth of reform, because structural and institu-
tional adjustment takes time, even when policy change is rapid. Countries
are placed in one of four reform groups, or in a "regional tensions" category
if they experienced major and persistent conflicts or conflict-related block-
ades during the period.

Section III presents cross-country evidence on the interaction between liber-
alization and economic growth (or contraction) and inflation. Section IV ex-
tends the analysis by looking at the time profile of the transition experience. We
estimate a regime-switching equation to generate a profile for the years before
reform and the years of reform for a typical country. Section V considers macro-
economic and sectoral patterns underlying growth, and section VI those under-
lying inflation.

Section VII addresses a deeper question: What accounts for economic liberal-
ization? Many characteristics, including history and culture, affect policy choice.
But here we look at political change. A close relationship is found between eco-

nomic liberalization and political reform, as measured by a widely used index of political freedom. Section VIII summarizes the main conclusions and their implications for policy debates.

Before proceeding with any empirical paper on transition economies, very serious weaknesses in the data must be noted.[2] Under central planning, the output of state enterprises was often exaggerated, whereas during the transition, output of the private sector has tended to be underreported, sometimes by large margins. Inflation is also difficult to measure because of sharp changes in the quality and composition of goods and because the base period is characterized by serious shortages at fixed official prices. Trade and balance of payments data are difficult to interpret consistently over time because of inconsistent bilateral exchange rates used in Council for Mutual Economic Assistance (CMEA) trade and because of problematic data for intra–U.S.S.R. trade. Cross-border trade is now difficult to monitor. We have an idea of the likely direction of most statistical biases, but their extent may differ among countries. Given these uncertainties, this article emphasizes broad trends and large, rather than fine, observed differences.

I. HOW LIBERALIZATION AFFECTS THE TRANSITION ECONOMY: A CONCEPTUAL FRAMEWORK

To the extent that transition economies share a common legacy of central planning, economic liberalization affects them in similar ways. Of course, country experience is also affected by initial conditions (table 1). Later we use data on income per capita to help explain the severe drop in output in many higher-income countries. Estimates of monetary overhang help to explain inflation, which was higher in countries with large monetary overhangs, and the excess of the actual over the predicted industry share in gross domestic product (GDP) is relevant to the discussion in section V on the important role of changes in the sectoral composition of output. Ongoing research suggests that these and other initial conditions affect economic performance but that the basic relationships between economic performance and liberalization described later still hold.[3]

Here, we identify four important features of the common legacy and also the corresponding changes that can be expected to occur with transition. This conceptual framework relates economic developments to liberalizing reforms and helps us predict the likely effect of liberalization on inflation and growth in countries of Central and Eastern Europe and the former Soviet republics. The framework applies most closely in situations in which a market system suddenly replaces pervasive central planning.

2. For more discussion, see EBRD (1994), and Balcerowicz and Gelb (1995) and the references therein.
3. See de Melo, Denizer, Gelb, and Tenev (1996) and de Melo and Gelb (1996) for an exploration of the nature and importance of initial conditions and other country-specific factors in the transition experience.

Table 1. *Selected Initial Conditions in Central and Eastern Europe, the Former Soviet Republics, and Mongolia, 1989*

Country	Per capita GNP at purchasing power parity (1989 U.S. dollars)	Monetary overhang as percentage of GDP[a]	Actual minus predicted industry share in GDP[b]
Central and Eastern Europe			
Albania	1,400	4.3	0.03
Bulgaria	5,000	18.0	0.23
Croatia	6,171	12.0	0.01
Czechoslovakia	6,280	−7.1	0.21
Hungary	6,810	−7.7	−0.01
Macedonia, FYR	3,394	12.0	0.09
Poland	5,150	13.6	0.13
Romania	3,470	16.8	0.22
Slovenia	9,200	12.0	0.05
Former Soviet Union			
Armenia	5,530	25.7	0.20
Azerbaijan	4,620	25.7	0.08
Belarus	7,010	25.7	0.12
Estonia	8,900	25.7	0.10
Georgia	5,590	25.7	0.08
Kazakstan	5,130	25.7	−0.04
Kyrgyz Republic	3,180	25.7	0.06
Latvia	8,590	25.7	0.10
Lithuania	6,430	25.7	0.10
Moldova	4,670	25.7	0.02
Russian Federation	7,720	25.7	0.07
Tajikistan	3,010	25.7	0.00
Turkmenistan	4,230	25.7	−0.01
Ukraine	5,680	25.7	0.04
Uzbekistan	2,740	25.7	−0.04
Mongolia	2,100	7.6	0.01

a. Monetary overhang is calculated as the percentage change in real wages minus the percentage change in real GDP over 1987–89.

b. The predicted share of industry is derived using the regression results from Chenery and Syrquin (1989). GDP is measured in current prices.

Source: World Bank data.

The four main economic features of central planning were as follows:

- *Macroeconomic balance by direct control.* Nominal prices and wages were fixed in socialist economies. Interfirm financial flows were the passive outcome of central directives. Only wages were paid in cash. They therefore determined household purchasing power, and the level of wages was the critical factor for balancing supply and demand. Before the collapse of the old regime, wage increases often exceeded upward adjustments in prices and the ability of the economy to provide consumer goods. As a result, consumer goods were rationed, and households were left with an involuntary

accumulation of financial assets—or a monetary overhang associated with repressed inflation.

- *Coordination through plans.* Economic activity was based on a central plan, with quantitative output targets specified in physical units. Heavy industry was accorded priority over consumer goods, and service sectors were repressed and accorded low priority in the allocation of resources. Domestic trade was carried out by centralized organizations, and the CMEA system linked most Central and Eastern European countries and Mongolia into the highly planned economy of the U.S.S.R.
- *Little private ownership.* With few exceptions, all property belonged to the state, and private ownership was not allowed. The lack of a profit motive, arising from the absence of private ownership, hurt efficiency. So did the concentration of activity in large firms, which were more compatible with the system of planned allocations.
- *Distorted relative prices.* Prices played an accounting role and were set in accordance with the central plan. Implicit prices of essentials—including housing, energy, transportation, education, and medical care—were kept low, and land prices were essentially zero. Implicit trade margins were low, and prices of final goods did not reflect differences in distribution costs.

After glasnost provided enough of a window of opportunity for the Central and Eastern European countries to break away from Soviet trade, the U.S.S.R. itself dissolved. Thus, in countries of both Central and Eastern Europe and the former Soviet republics, major disruptions occurred in the economic coordinating mechanism. This situation can be distinguished from that in China and Vietnam, where central planning was less pervasive, with less disruption in economic coordinating mechanisms, as liberalizing reforms were introduced earlier. In the wake of this disruption, countries chose to make the transition from socialism to a market economy, although some countries introduced reforms more rapidly than others.

What happens when a planned economy is replaced by a market system with liberalized prices, trade, and private sector entry?[4] Each of the above features has a counterpart in the systemic changes that occur during transition. The following changes occur because of the disintegration of the old regime and in response to active measures of economic liberalization:

- *Initial macroeconomic destabilization followed by restabilization.* When prices and wages are liberalized initially, stability is lost. Prices typically increase, especially if they are freed under conditions of repressed inflation. The immediate challenge for macroeconomic policy is to slow the rate of price increase and reverse inflationary expectations and flight from domestic

4. Parts of the answer to this question appear in various studies. See Berg and Sachs (1992), Berg (1993), Chadha, Coricelli, and Krajnyak (1993), Ickes and Ryterman (1993), Aghion and Blanchard (1994), Kornai (1994), and Taylor (1994).

financial assets. This change requires a conversion from a passive to an active monetary policy, characterized initially by the reintroduction of one or more nominal anchors (money supply, exchange rate, wages). Inflationary pressures may persist because of attempts to maintain the old production structure, which featured the granting of large subsidies to state enterprises. But liberalization of prices, trade, and private entry can facilitate restructuring and hence a reduction in such subsidies. This reduction, in turn, allows inflation to fall.

- *Output declines from disruptions in the coordinating mechanism.* The sudden abolition of planning in a complex, highly interdependent economy can impair economic coordination. This disruption affects both useful and unwanted production—until an efficient system of market coordination evolves. The short-term increases in transaction costs can be considered a negative supply shock to an economywide production function, which includes coordination activities (such as trade and payments, including those between newly independent states) as an intermediate sector. The fall in output—and the delay in recovery—will be greater the higher the initial reliance on central planning, the more the planning system is disrupted, and the slower the development of a new, market-based coordinating system in response to liberalization.

- *Output gains from private ownership and private sector growth.* Efficiency gains come from the legalization of private ownership within the framework of a market economy with flexible prices. Thus, growth should respond to economic liberalization as well as to the facilitation of entry of new private firms and the establishment and enforcement of a legal framework to support private activities. Efficiency gains also arise from increased competition among smaller, client-oriented firms in the new private sector.

- *Microeconomic and sectoral reallocations.* Microeconomic and sectoral reallocations occur in response to price changes resulting from price and trade liberalization and cuts in subsidies. They also reflect changes in demand. Previously repressed sectors, notably services, are expected to expand and offset declines in industry and agriculture, which were overbuilt and heavily subsidized in many planned economies. The reallocation of resources away from activities for which there is low demand and toward activities with growth potential should raise output.

These factors suggest that output will fall initially, and recover subsequently, in response to liberalization, with repressed sectors increasing their weight in the economy. Inflation will increase initially, and fall subsequently, in response to liberalization. Below, we assess the extent to which the economic performance of transition countries in Central and Eastern Europe and the former Soviet republics conforms to the experience predicted by this conceptual model of transition and, in particular, the extent to which accelerated liberalization facilitates restabilization and the recovery of growth.

II. Country Experience with Economic Liberalization

To explore broad cross-country relationships among growth, inflation, and liberalization, we construct an annual index of liberalization for the transition period beginning in 1989. We then use this index to classify countries into reform groups according to their cumulative experience with economic liberalization as of the end of 1994.

Growth is represented by annual changes in real, officially measured GDP, and inflation is represented by changes in the average annual consumer price index (CPI). Liberalization is measured by an index that we constructed for this analysis. We calculate an annual liberalization index for each country for each year from 1989 to 1994. The index ranges from 0 to 1, with 0 representing an unreformed country and 1 representing an extensively reformed country. The liberalization index is the weighted average of the rankings of liberalization in the following three areas:

- Internal markets (I)—liberalization of domestic prices and the abolition of state trading monopolies (weight: 0.3)
- External markets (E)—liberalization of the foreign trade regime, including elimination of export controls and taxes, and substitution of low-to-moderate import duties for import quotas and high import tariffs; current-account convertibility (weight: 0.3)
- Private sector entry (P)—privatization of small-scale and large-scale enterprises and banking reform (weight: 0.4).

The indicators used for P are proxies for opening up the economy to private sector development. They do not capture the overall quality of the legal and regulatory framework or the effectiveness of the government at institution building or at implementing reforms—but only because of the difficulty of developing comparative measures. Because of strong complementarity among the components, varying their relative weights does not result in substantially different correlations with growth and inflation.

We followed an extensive process of consultation in assigning annual country rankings for each component of the liberalization index. First, we proposed rankings on the basis of our own knowledge and country reports. Second, we consulted World Bank and other country specialists on a country's pace of reform and on its ranking in relation to other transition countries known by the specialist. Third, we submitted these revised rankings to relatively senior experts having a comparative perspective across a wider range of countries. And fourth, for the twenty-five countries in Central and Eastern Europe and the former Soviet republics, we made a further adjustment to reflect the transition indicators given in EBRD (1994, table 2.1 and the accompanying text).[5]

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5. For a complete listing of the values given to the three components of the liberalization index by country and by year, and for a fuller explanation of how the index was derived, see de Melo, Denizer, and Gelb (1996).

Cross-country means for I and E show large increases in 1991, reflecting reform in Central and Eastern European countries, and in 1992, reflecting reform in countries of the former Soviet republics. The mean for P shows a more modest but steady increase over the whole period. Comparing means in 1989 with those in 1994, we see that the greatest progress has been achieved in the liberalization of internal markets and the least in private sector entry. Standard deviations for I and E peaked in 1991. They have since declined, especially for I, reflecting the fact that most countries had moved ahead on internal price liberalization by 1994, even though no country had fully liberalized prices. The standard deviation for P increases over time because privatization leaps ahead in some countries but lags in others.

Economic performance at any given moment is determined not only by the degree of liberalization currently prevailing but also by the structural, institutional, and behavioral changes stimulated by prior policy reforms. We therefore define a cumulative liberalization index (CLI) to represent the duration as well as the intensity of reforms from 1989 onward. We calculate the CLI as the sum of a country's liberalization indexes. The CLI represents a combination of the depth and duration of reform. In principle, it would be possible to specify a decay function to fine-tune the balance between current levels of reform and cumulative experience with reform. But there is no obvious basis for specifying the rate of decay. Sensitivity analysis using a decay function with gradually declining weights over time shows similar results to the CLI constructed as the simple sum of annual liberalization indexes. Countries are included in one of four reform groups, determined by natural breaks in the CLI values (table 2):

- Group 1: Advanced reformers ($CLI > 3$)
- Group 2: High-intermediate reformers ($2 < CLI < 3$)
- Group 3: Low-intermediate reformers ($1.3 < CLI < 2$)
- Group 4: Slow reformers ($CLI < 1.3$)

Countries affected by regional tensions are shown separately because their economic performance was adversely affected by noneconomic events. Countries with regional tensions include former Yugoslav and Soviet republics that have experienced major and persistent internal conflicts from 1989 to 1994 or, in the case of Armenia and FYR Macedonia, countries that have suffered from blockades. The CLI varies widely across this group.

The three components of the liberalization index are highly correlated with each other, suggesting that there is a high degree of complementarity in designing and implementing different types of reform. Correlation is somewhat higher between I and E than between either of these and P. Pearson correlations are 0.93 (I and E), 0.84 (I and P), and 0.82 (E and P). Spearman rank correlations are slightly higher. The matrix of (Pearson) correlation coefficients shows that the CLI is more strongly associated with growth and inflation than is the cumulative index of any one component (table 3).

Table 2. *Liberalization, Growth, and Inflation in Twenty-Six Countries in Transition, 1989–94*

Country	Cumulative liberalization index[a] 1994	Average liberalization[b] 1993–94	Average annual inflation 1993–94 (percent)	Average annual growth in GDP 1993–94 (percent)	Average annual GDP in 1993–94 as a percentage of 1989 GDP	Lowest level of GDP as a percentage of 1989 GDP
Advanced reformers						
Slovenia	4.16	0.82	26	3.0	84	81
Poland	4.14	0.84	34	4.2	88	82
Hungary	4.11	0.84	21	0.0	81	80
Czech Republic	3.61	0.90	16	0.8	81	80
Slovak Republic	3.47	0.86	19	0.4	79	77
Average	3.90	0.85	23	1.7	83	80
High-intermediate reformers						
Estonia	2.93	0.85	69	0.9	69	67
Bulgaria	2.90	0.68	81	−1.4	73	73
Lithuania	2.72	0.79	231	−7.3	44	44
Latvia	2.45	0.71	73	−4.4	60	59
Albania	2.30	0.70	57	9.5	74	65
Romania	2.29	0.66	194	2.2	69	67
Mongolia	2.27	0.64	164	0.6	84	83
Average	2.55	0.72	124	0.03	67	65
Low-intermediate reformers						
Russian Federation	1.92	0.63	558	−13.5	57	52
Kyrgyz Republic	1.81	0.68	744	−13.2	61	57
Moldova	1.62	0.53	558	−17.0	53	46
Kazakstan	1.31	0.37	1,870	−18.5	57	49
Average	1.67	0.55	933	−15.6	57	51
Slow reformers						
Uzbekistan	1.11	0.37	640	−2.5	89	88
Belarus	1.07	0.35	1,694	−16.6	73	64
Ukraine	0.80	0.20	2,789	−18.6	56	48
Turkmenistan	0.63	0.19	2,751	−15.0	69	62
Average	0.90	0.27	1,968	−13.2	72	66
Affected by regional tensions						
Croatia	3.98	0.83	807	−0.7	69	68
Macedonia, FYR	3.92	0.78	157	−10.7	57	55
Armenia	1.44	0.42	4,595	−7.4	38	38
Georgia	1.32	0.35	10,563	−24.6	24	23
Azerbaijan	1.03	0.33	1,167	−17.7	50	44
Tajikistan	0.95	0.28	1,324	−26.3	35	30
Average	2.11	0.50	3,102	−14.5	45	34

a. The sum of a country's annual liberalization indexes for 1989–94. See section II of the text for details.

b. See section II of the text for details.

Source: Authors' calculations.

Table 3. *Correlation between Components of the Liberalization Index and Growth and Inflation*
(correlation coefficient)

	Component of liberalization index			Cumulative liberalization index, CLI
Indicator	Internal markets	External markets	Privatization	
Average annual growth in GDP				
1989–94	0.57	0.52	0.60	0.59
1993–94	0.72	0.69	0.67	0.73
Average annual inflation rate				
1989–94	−0.72	−0.67	−0.73	−0.74
1993–94	−0.80	−0.75	−0.79	−0.81

Note: See section II of the text for details about construction of the liberalization index. The sample includes all the twenty-six countries in table 2.
Source: Authors' calculations.

III. GROWTH, INFLATION, AND LIBERALIZATION

Following the dissolution of the CMEA and the ruble zone, each country in Central and Eastern Europe and the former Soviet republics has followed its own path to reform with varying speeds and intensities. Here, however, we explore the hypothesis that, despite the diversity in country circumstances, there are simple cross-country relationships between real GDP growth and economic liberalization, inflation and economic liberalization, and growth and stabilization. The statistical analysis below suggests that country experience during the transition is strongly associated with liberalization and that the return to positive growth is associated with declines in inflation to double digits or less.

Growth and Liberalization

A systematic relationship between output and reform by country group is apparent from table 2. This relationship confirms the anticipated output gains associated with liberalization. Although output fell initially, advanced reformers were stable or growing by 1993–94, and their lowest output levels were about 80 percent of those in 1989. High-intermediate reformers lost about a third of their GDP, but most also stabilized output. Albania experienced high growth, benefiting from high external financing. Low-intermediate reformers fared the worst, with continuing output losses through 1994. The slowest reformers managed to contain their output declines somewhat, and Uzbekistan appears to have defied the general pattern by avoiding a major decline. The cost of regional tensions is highlighted by huge, cumulative declines in output.

For the twenty countries not affected by regional tensions, the relationship between output growth in 1993–94 and the CLI fits a simple quadratic (figure 1). This suggests that more than half the variation in real growth was associated

Figure 1. *Growth and Liberalization in Twenty Countries in Transition*

Average annual growth in GDP, 1993–94 (percent)

Cumulative liberalization index, 1994 [a]
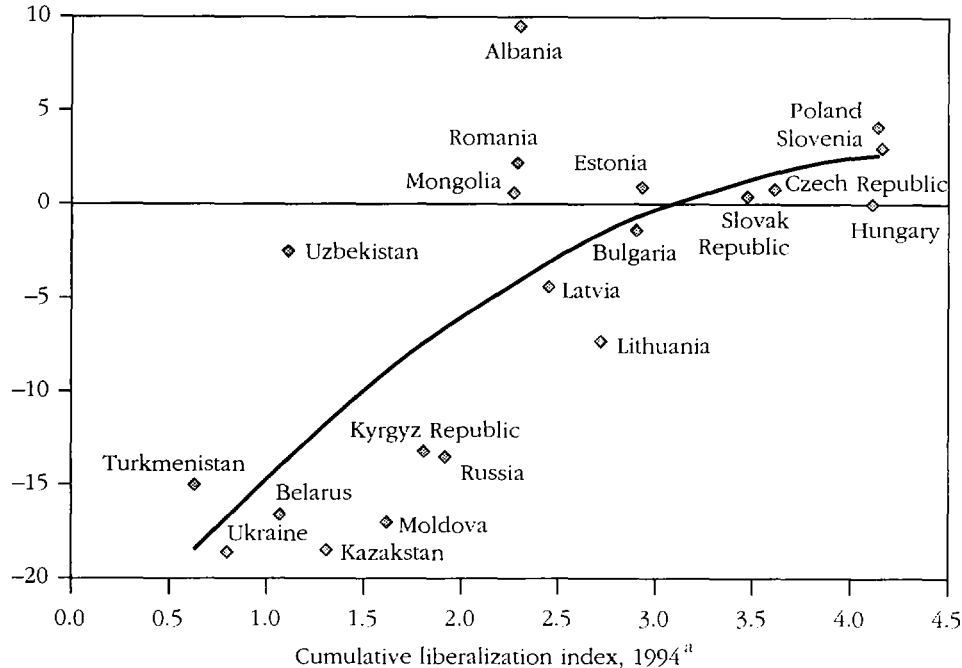
Note: The curve is given by $y = 26.1 + 12.8x - 1.42x^2$, with adjusted $R^2 = 0.53$.
a. See section II of the text for details about the construction of the index.
Source: Authors' calculations based on World Bank data.

with increases in economic liberalization, with growth turning positive when the *CLI* reached 3 or higher. The fit is better for this equation, as well as for the inflation equation (figure 2), than an equation in which the independent variable is simply the recent annual liberalization index. This result confirms that the duration, as well as the intensity, of reforms is relevant.

Figure 1 seems to have two sets of countries—one with a low *CLI* and large negative growth and one with a high *CLI* and a better growth record—but there may be factors other than liberalization that determine growth. We supplement the partial correlation for the twenty countries shown in figure 1 by looking at the relationship between average growth (*AVGR*) and economic liberalization during the full six years of transition (1989–94) for all twenty-six countries. Two other variables are included in the regression analysis. Per capita income in 1989 (*PCY*) is introduced, showing an expected negative sign, to allow for a lower level of central planning and associated overindustrialization in the lower-income countries of Central Asia. It may also capture other phenomena, such as short-run convergence effects or the ability of countries with relatively large

Figure 2. *Inflation and Liberalization in Twenty Countries in Transition*

Average inflation, 1993–94
(percent, log scale)

Cumulative liberalization index, 1994[a]
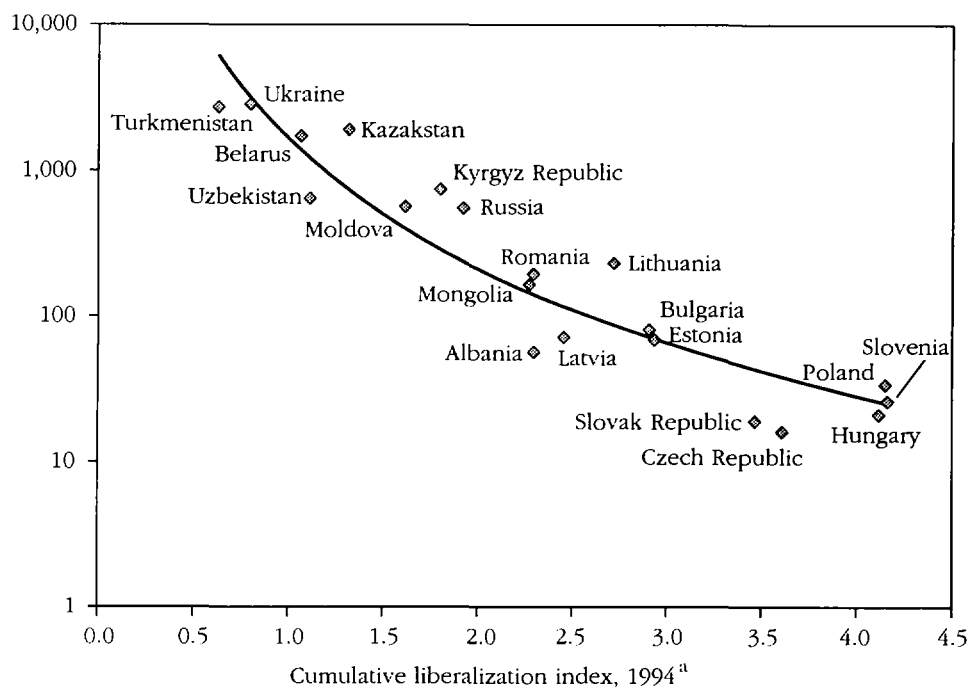
Note: The curve is given by $y = 1656.7x^{-2.9354}$, with $R^2 = 0.8731$.
a. See section II of the text for details about the construction of the index.
Source: Authors' calculations based on World Bank data.

agricultural sectors, such as Albania or Romania, to respond more quickly to price incentives. A dummy variable (*RT*) distinguishes countries affected by regional tensions. The numbers in parentheses are *t*-statistics.

(1) $AVGR =$ $-9.1 + 2.6\ CLI - 0.54\ PCY - 6.5\ RT$ Adjusted $R^2 = 0.65$
        (5.4) (4.7)   (1.9)   (4.8)

The equation supports the hypothesis that substantial, sustained liberalization has a strong positive growth effect within the overall context of a "transitional recession," that is, the contraction-recovery cycle. Here, a linear relationship to the *CLI* fits better than a quadratic one, suggesting that the positive impact of economic liberalization on growth over this longer period is equally strong at the higher and lower rates of growth. The coefficient for *PCY* suggests that the average annual growth in output is about 3 percentage points less in the highest-income countries than in the lowest-income countries. The dummy variable for regional tensions shows that such

tensions are associated with an average annual decline in GDP of 6.5 percentage points.

Inflation and Liberalization

Inflation in 1993–94 shows systematic variation across reform groups (table 2) and a strong negative relationship with economic liberalization (figure 2). In general, advanced reformers have been relatively successful in containing the inflationary bursts that followed price liberalization, but slower reformers have endured longer and more severe bouts of inflation.

Here, too, we supplement the partial correlation with additional variables and a longer time period to obtain a fuller view. Equation 2 confirms a strong negative relationship between inflation and cumulative economic liberalization from 1991 to 1994. This latter period, rather than the full six years, is used in the equation for the average log of inflation (*AVLIN*) to avoid the effects of high, inherited open inflation in Poland and the former Yugoslav republics. *LCLI* denotes the log of the *CLI. LDROP* represents the log of the maximum drop in the annual index of real GDP for each country (1989 = 100). *MONOV* represents monetary overhang. It is estimated by the increase in wages, deflated by the official CPI, less the change in real GDP during the prereform period, 1987–89 (see table 1). Because only wage payments were made in cash under socialism, increases in wages for a given change in GDP result in a buildup of household financial assets—and hence a monetary overhang. *RT* has the same definition as before, and the numbers in parentheses are *t*-statistics.

$$(2) \quad AVLIN\ 91\text{–}94\ =\ 3.4 - 0.88\ LCLI + 0.64\ LDROP + 0.036\ MONOV + 1.2\ RT$$
$$\qquad\qquad\qquad (2.4)\ (2.3) \qquad (1.5) \qquad\quad (2.1) \qquad\qquad (2.8)$$
$$\text{Adjusted } R^2 = 0.76$$

Equation 2 shows that countries with larger maximum output declines (larger *LDROP*s) experienced higher inflation, possibly because of the impact of lower money demand on the inflation tax base. Higher inflation also occurred in countries with higher levels of monetary overhang and countries subject to regional tensions.

Growth and Stabilization

In market economies it has usually been assumed that stabilization carries a cost in terms of growth. But more recent research suggests that reducing inflation from very high levels can coincide with a period of expansion (Easterly 1996), and table 2 suggests that output recovery in transition economies in Central and Eastern Europe and in the newly independent states has been associated with falling inflation. Although both inflation and growth are considered to be dependent on liberalization policy (and on associated stabilization policies, as discussed below), there may be two-way interactions between these variables. Lower inflation can enable the price mechanism to work, and growth can have a favorable impact on budget deficits, reducing inflationary pressures.

Looking at changes in output against experience with stabilization, we see that a return to positive growth typically requires that inflation drop below 100 percent a year (figure 3). An important policy implication is that the recovery of output in Central and Eastern Europe and in the former Soviet republics requires inflation to be reduced to moderate levels. The numbers in figure 3 confirm that sustained economic liberalization facilitates both growth and stabilization.

IV. The Time Profile of Growth and Inflation

Are there common patterns in the time profiles of country experience that go beyond these cross-sectional relationships? Here, we estimate "regime-

Figure 3. *Growth and Stabilization in Twenty Countries in Transition, 1989–94*

Average annual growth in GDP (percent)
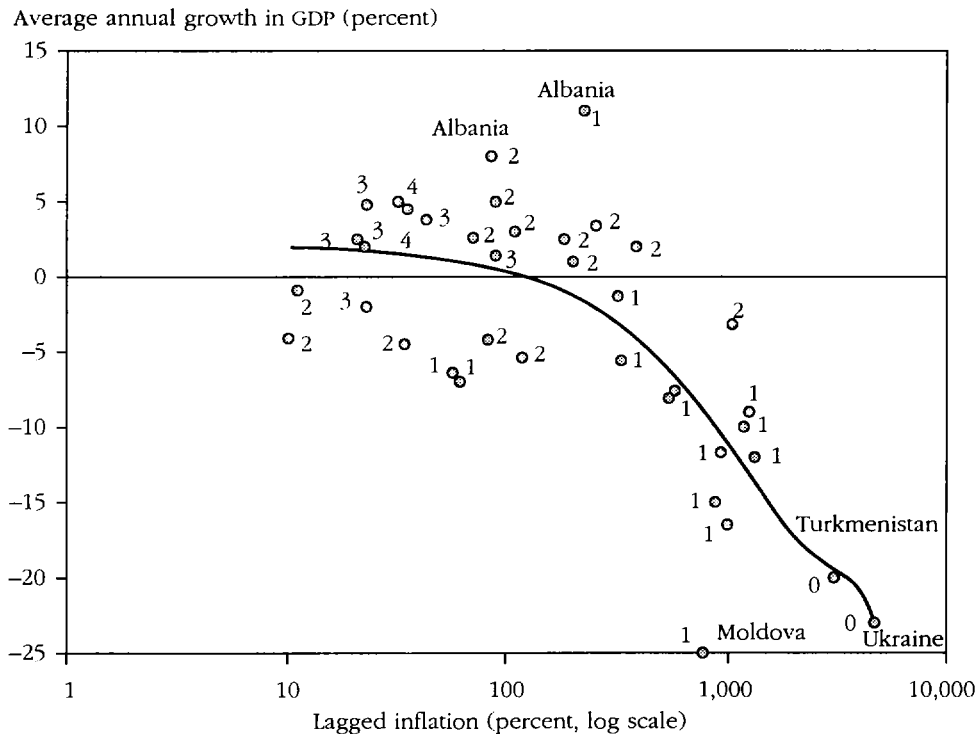
Note: For each country, a point is plotted for the year in which the highest level of inflation occurred and all subsequent years. Inflation is measured as the annual average from the year before the year of GDP growth. The values assigned to each point denote the cumulative liberalization index for that country and year. See table 2 for a list of the twenty countries included (countries affected by regional tensions are excluded). The curve is given by $y = -5E - 10x^3 + 5E - 06x^2 - 0.0176x + 2.1285$, with $R^2 = 0.065$.

Source: Authors' calculations.

switching" equations to generate stylized profiles of growth and inflation for years before reform and for years of reform.

To estimate a regime-switching equation across the twenty-six countries, we need to define the year in which a regime changes from planned to market. This is easy for countries such as Poland that made a decisive change in a given year. It is more difficult for countries where reform has been gradual or partial. To avoid arbitrary specification of the switch points, we base the change of regime on the *CLI*. First, the *CLI*s are rescaled so that Poland has five reform years by the end of 1994, implying a shift to a new regime in January 1990. All *CLI*s are normalized by the same factor; that is, all countries' reform experiences are being judged in Poland-equivalent reform years.[6] To derive the switch point, we round off the scaled *CLI* to the nearest year and subtract the result from 1995. With this method, each country has at least one observation in the reform regime and one in the nonreform regime. For example, Poland has one observation (1989) in the nonreform regime and five observations (1990–94) in the reform regime. Turkmenistan, with the lowest *CLI*, has five observations (1989–93) in the nonreform regime and one (1994) in the reform regime.

The switching equations specifying the time profiles of growth (*GR*) and inflation (*INFL*) in relation to reform are then

$$GR(INFL) = a + \sum_{i\ 89}^{R-1} b_i D_i^B + \sum_{j=R}^{94} c_j D_j^A + dRT$$

where D_i^B are dummy variables for the successive years before reform begins for each country, starting in 1989, D_j^A are dummy variables for successive years after reform begins, R is the constructed year of reform, and RT has already been defined.

When added to the intercept, the estimated coefficients (in table 4) yield the growth and inflation time profiles of a representative country in a regime of nonreform (the *b* coefficients) and a regime of reform (the *c* coefficients).

The growth regression shown has reasonably good explanatory power. Reformers experience a sharp initial contraction in the first year of reform, followed by a return to positive growth in year four (figure 4). Caught in the deteriorating environment of a disintegrating economic system, countries in the years before reform initially succeed in delaying the decline, but output then contracts at an accelerating rate. After three years their GDP is lower than that of the reformers. The status quo is not a viable option for countries with severely over-

6. We considered other alternatives: setting the switch point according to the announcement of a comprehensive reform program (as in EBRD 1994) or setting the switch point according to the year of maximum increase in the liberalization index. The first procedure was unsatisfactory because announced programs are sometimes not carried out. The second does not take into account the actual degree of reform. In any case, the general pattern of results is surprisingly robust to a variety of ways of deriving the switch point from the *CLI* (see de Melo and Gelb 1996).

Table 4. *Regime-Switching Regressions for Twenty-Six Countries in Transition, 1989–94*

Variable	Growth		Log inflation	
	Coefficient	Profile[a]	Coefficient	Profile[a]
Years before reform				
Five	14.2	1.6	–4.4	1.6
	(6.7)		(10.6)	
Four	8.3	–4.3	–4.1	1.9
	(3.7)		(9.3)	
Three	2.5	–10.1	–1.5	4.5
	(1.1)		(3.2)	
Two	–6.6	–19.2	0.4	6.4
	(2.5)		(0.7)	
One	2.8	–9.8	1.0	7.0
	(0.8)		(1.5)	
Years of reform (intercept)				
First	–12.6	–12.6	6.0	6.0
	(8.3)		(20.2)	
Second	5.6	–7.0	–0.7	5.3
	(2.5)		(1.6)	
Third	11.3	–1.3	–2.1	3.9
	(4.5)		(4.3)	
Fourth	13.8	1.2	–2.3	3.7
	(4.7)		(4.0)	
Fifth	15.5	2.9	–2.9	3.1
	(4.2)		(4.0)	
Regional tensions dummy, RT	–0.9	–21.6	1.4	7.4
	(4.7)		(3.7)	
R^2	0.51		0.65	
Adjusted R^2	0.48		0.63	

Note: See section IV of the text for the regime-switching equations. Regressions are based on observations of twenty-six countries (see table 2). *t*-statistics are in parentheses.

a. Coefficient plus intercept. This is the predicted annual growth or inflation rate.

Source: Authors' calculations.

built sectors experiencing severe disruptions in internal and external economic coordination. Although, theoretically, it is possible to follow a gradualist reform program, evidence suggests that gradualism has not paid off in this region. Simulation exercises, undertaken to assess the robustness of these results to probable patterns of bias in the underreporting of GDP, provide similar results (see de Melo, Denizer, and Gelb 1996). The coefficient for countries affected by regional tensions indicates a high, statistically significant additional cost. Each year of regional tensions reduces output by an additional 9 percentage points.

The stage of liberalization is a surprisingly strong predictor of inflation (figure 5). As expected, freeing markets is associated with a sharp price spike in the first year. In subsequent years inflation is usually brought down—to about 20 percent after four years. Slow reformers initially manage to contain inflation to

Figure 4. *Growth Profiles for Years before Reform and Reform Years for Twenty-Six Countries in Transition, 1989–94*

Average annual growth in GDP (percent)
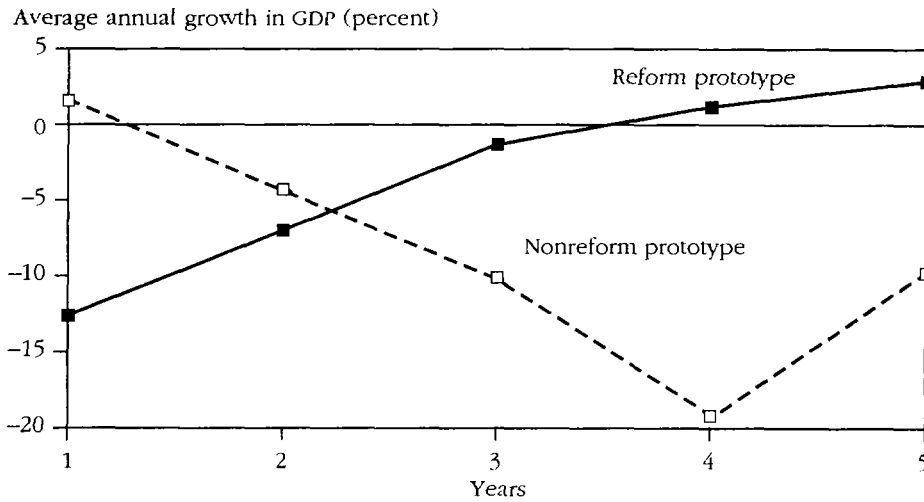
Note: The growth profiles are based on regression coefficients for twenty-six countries (see table 2 for a list of the countries). The years before reform and the years of reform are based on the normalized cumulative liberalization index as defined in the text.

Source: Authors' calculations.

Figure 5. *Inflation Profiles for Years before Reform and Reform Years for Twenty-Six Countries in Transition, 1989–94*

Log inflation
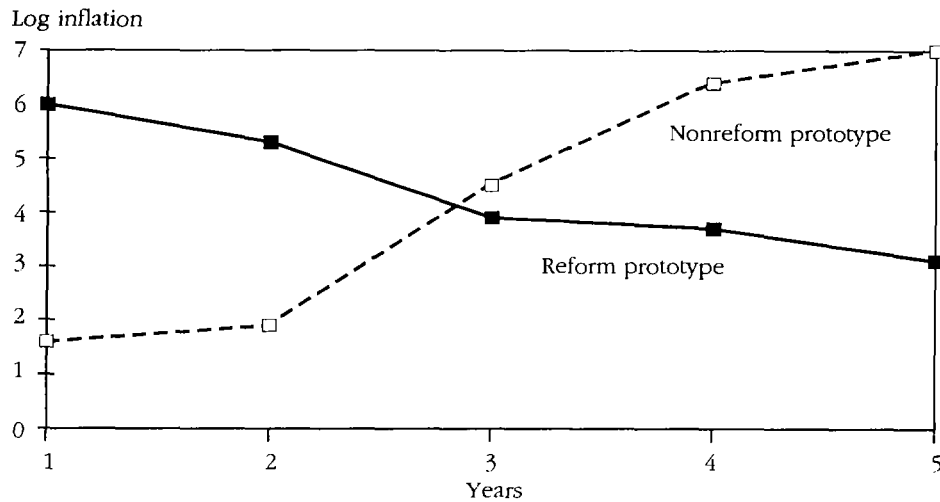
Note: The growth profiles are based on regression coefficients for twenty-six countries (see table 2 for a list of the countries). The years before reform and the years of reform are based on the normalized cumulative liberalization index as defined in the text.

Source: Authors' calculations.

moderate levels. After three years, however, their inflation rates soar far above the peak levels in reforming countries, as their economies contract sharply. As might be expected, countries affected by regional tensions experience much higher inflation rates.

V. Patterns Underlying Growth

Why do growth rates recover after a period of liberalization and stabilization? In theory, there are several possibilities on both the demand and supply sides, but in practice the recovery of growth appears to be driven by a few key factors. On the demand side, the growth of exports to market economies has been more significant in the more liberalized countries (see Kaminski, Wang, and Winters 1996 for evidence). But fixed investment levels in relation to GDP differ only slightly across reform groups (see de Melo, Denizer, and Gelb 1996). On the supply side, recovery appears to be driven by the reallocation of factors to more productive activities rather than by factor accumulation. This reallocation is characterized by the growth of previously repressed sectors and activities. The evidence suggests that structural change has resulted directly from liberalization and that it has been greater in advanced and high-intermediate reformers.

Private activities have expanded very rapidly in many countries (private GDP now accounts for at least 50 percent of GDP in the advanced reformers), partly because of autonomous growth and partly because of privatization. It is difficult to distinguish the net impact of each on growth, although sectoral reallocation can be tracked. National accounts data show the shifts of output in current prices between broad production sectors by reform group (table 5). The more advanced reformers have experienced an accelerated shift from overbuilt industry toward services. This shift reflects higher profitability in the growing sectors, which lead output recovery.

On average, the share of services (at current prices) in GDP has increased by 15 percentage points in the advanced reformers, by 10 percentage points in the

Table 5. *Sectoral Shifts in Production at Current Prices after Liberalization and Stabilization, by Country Reform Group, 1989–94*

Country reform group	Cumulative liberalization index[a]	Change in share of GDP (percent)		
		Industry	Agriculture	Services
Advanced reformers	3.91	–11.2	–3.7	14.9
High-intermediate reformers	2.55	–11.0	0.7	10.4
Low-intermediate reformers	1.66	–1.9	–4.9	6.8
Slow reformers	0.90	2.9	–1.4	–1.5
Affected by regional tensions	2.11	–7.9	15.3	–7.4

Note: The countries in each group are listed in table 2.
a. See section II of the text for details about the construction of the index.
Source: Authors' calculations based on World Bank data.

high-intermediate reformers, and by 7 percentage points in the low-intermediate reformers. These shifts have occurred despite the fact that between 1990 and 1992 services fell in relation to GDP in almost all countries of the former Soviet republics—because of a precipitous decline in government (including military) services. Growth in services has been concentrated in private trade, finance, and other business and consumer services. These activities have contributed strongly to the generation of private wealth, which in some countries is now being used to acquire industrial assets. One example is the 1995 purchase of Russian energy companies by a consortium of Russian banks. Service growth is severely understated because of the underreporting of private activity, but its growth may also be exaggerated by the fact that many services were previously incorporated into industrial firms and not separately distinguished.

In the more advanced reformers, industry's share has fallen across the board, including the shares of military production, heavy industry, and consumer manufactures that are not competitive with imports. A striking development has been the sharp deconcentration of industrial employment by firm size (see, for example, Kornai 1994; Balcerowicz and Gelb 1995)—a result of new private entry, layoffs from the state sector, and the breakup of large state firms, sometimes in the course of spontaneous processes separating good and bad assets prior to formal privatization.

According to official statistics, the shift away from industry has not taken place in the countries with low *CLIs*. Indeed, industry's measured share has actually risen for some low-intermediate and slow reformers. Service sectors in these countries are certainly larger than official estimates purport, but they are more poorly developed than in countries with high *CLIs*.

The relative performance of agriculture varies considerably among countries. Prereform agriculture was inefficiently organized but benefited from subsidies, including those for credit, energy, and other inputs. Performance during the transition reflects a variety of effects, including privatization in some countries, relative price changes (which have especially squeezed profits in livestock sectors), and a critical emerging shortage of liquidity at the farm level. Output patterns in countries affected by regional tensions are distinctive: faced with overestimated, but still very large, declines in aggregate activity, populations have retreated toward subsistence farming.

VI. PATTERNS UNDERLYING INFLATION

Why has inflation fallen following a program of liberalization in some countries but remained high in others? Possible explanations include the effect of exchange rate movements, conventional budget deficits, and quasi-fiscal deficits. The main cause of inflation appears to have been monetary expansion generated by high central bank subsidies and, possibly, other contributors to quasi-fiscal deficits, which have been larger and more persistent in less liberalized countries.

In both floating-rate and pegged-rate countries, large depreciations in the real exchange rate occurred during the early stages of reform, as prices were freed and monetary overhangs were eliminated. These huge real devaluations sustained external balance but at the same time exacerbated inflationary pressures. Subsequently, however, exchange rates moved toward market rates that were twice the purchasing power parity (PPP) rate—a ratio consistent with those for countries at comparable levels of PPP income (Balcerowicz and Gelb 1995). Thus, imported inflation affected the domestic price level early on, but the later appreciation of the real exchange rate supported stabilization efforts.

Conventional fiscal deficits rose on average for all groups, except the advanced reformers, between 1989 and 1994. As of 1994, deficits averaged 2 percent of GDP in advanced reformers and 7 percent of GDP in intermediate reformers, although they were surprisingly modest in slow reformers that were still experiencing very high inflation. Revenue shares in GDP averaged 50 percent for the advanced reformers in 1994—only 4 percentage points lower than in 1989 (table 6).[7] At 33 percent of GDP on average, revenue in high-intermediate reformers was far lower in 1994 than in 1989. And at 24 percent of GDP, revenue shares were lowest in the low-intermediate reformers. This pattern is of considerable interest because it shows—contrary to some initial expectations—that faster-reforming countries have not necessarily experienced greater falls in fiscal revenue than have slower reformers. The surprisingly strong revenue performance of countries affected by regional tensions was largely due to the inclusion of foreign grants.

The remaining explanation for the continuation of high inflation in slower-reforming countries is the existence of large quasi-fiscal deficits—losses incurred by the central bank. There are no standard measures of quasi-fiscal losses, which may include financing for debt write-offs, subsidies given in connection with guarantees such as foreign exchange guarantees, and losses resulting from the provision of credit to banks and firms at highly negative real interest rates. Only the last category, which reflects attempts to maintain production and employment in existing firms and farms, can be calculated for a range of countries (table 7). Other components of the quasi-fiscal deficit are not available on a comparable basis. However, extrabudgetary debt write-offs have been estimated for Bulgaria as an additional 3.4 percent of GDP in 1992 and 3.8 percent of GDP in 1993. Such write-offs are known to exist in other countries, such as Hungary and Kazakstan. In China, central bank subsidies to state enterprises have been substantial, but because of rapid growth in the demand for money, their size has not yet caused excessive inflation (see McKinnon 1994; Yusuf 1994).

In countries featuring lagged reforms and resistance to structural change, the consolidated deficits have been much larger than open fiscal deficits. Central bank credit subsidies in the countries that are slow reformers have been on the order of three times the fiscal deficit, far exceeding any plausible estimate of tax

7. See EBRD (1994) and IMF (1994). The common pattern was for revenue to decline during the first year of reforms but to rebound in the second year.

Table 6. *Revenue, Expenditure, and Fiscal Balance, by Country Reform Group, 1989–94*

Country reform group	Cumulative liberalization index[a]	Change (percentage of GDP)			1994 level (percentage of GDP)		
		Revenue	Expenditure	Balance	Revenue	Expenditure	Balance
Advanced reformers	3.91	−3.6	−3.9	0.3	49.7	52.1	−2.4
High-intermediate reformers	2.55	−17.3	−13.5	−3.8	33.0	39.0	−5.9
Low-intermediate reformers	1.66	−14.6	−7.9	−5.9	24.2	31.8	−7.6
Slow reformers	0.90	−1.0	3.6	−3.4	32.0	35.5	−3.4
Affected by regional tensions	2.11	−1.2	7.1	−6.2	32.2	40.9	−8.6

Note: The countries included in each group are listed in table 2.

a. See section II of the text for details about the construction of the index.

Source: Authors' calculations.

Table 7. *Fiscal Deficits and Partial Quasi-Fiscal Expenditures for Selected Countries in Transition, 1992–94*
(percentage of GDP)

Country, by reform group	Fiscal deficit			Implicit subsidy from central bank[a]			Total		
	1992	1993	1994	1992	1993	1994	1992	1993	1994
Advanced reformers									
Poland	6.8	2.9	2.9	0.0	0.0	0.0	6.8	2.9	2.9
Hungary	5.7	7.0	6.5	0.0	0.0	0.0	5.7	7.0	6.5
Czech Republic[b]	0.5	−0.6	−0.5	0.3	0.8	0.1	0.8	0.2	−0.4
Slovak Republic[b]	13.1	7.6	2.5	0.3	1.7	0.0	13.4	9.3	2.5
Intermediate reformers									
Estonia	−0.5	1.4	0.0	—	0.2	0.3	—	1.6	0.3
Bulgaria	5.0	11.1	6.1	1.3	0.8	0.7	6.3	11.9	6.8
Romania	5.5	1.0	3.0	5.9	3.9	0.0	11.4	4.9	3.0
Russian Federation[c]	3.4	8.1	8.8	11.3	1.7	0.0	14.7	9.8	8.8
Kazakstan	7.3	1.2	4.5	32.7	—	2.6	40.0	—	7.1
Slow reformers									
Belarus[c]	6.4	9.4	1.5	26.5	9.3	3.4	32.9	18.7	4.9
Turkmenistan[c,d]	10.1	3.6	1.1	12.5	21.2	6.4	22.6	24.8	7.5
Uzbekistan[c]	10.2	8.4	2.0	13.1	18.5	19.0	23.3	26.9	21.0

— Not available.

a. The implicit subsidy from the central bank to commercial banks and the economy is due to the difference between inflation and the central bank refinancing rate on credit outstanding to the nongovernmental sector. Annual figures are averages of monthly figures, where available, or of quarterly averages.

b. For 1992 the nominal federation subsidy was divided 2-to-1 in favor of the Czech Republic.

c. Calculations made on a quarterly basis.

d. Turkmenistan's budget does not include the fiscal position of its three largest ministries and hence is not consolidated. If foreign borrowing of these ministries is taken into account, the budget deficits in 1993 and 1994 would be much higher and no less than 10 to 12 percent of GDP in each year.

Source: World Bank data and authors' calculations.

revenue recouped from subsidized firms. Only in the more advanced reformers, which more or less achieved stabilization and in which rapid structural change was in process, were these interest subsidies eliminated. Quasi-fiscal losses because of central bank subsidies have been the most important factor prolonging inflation in the slower reformers. Moreover, the existence of large quasi-fiscal losses in the slower reformers is consistent with data indicating much more rapid growth in base money, as well as broad money, in these countries (see de Melo and Denizer 1996).

VII. ECONOMIC LIBERALIZATION AND POLITICAL FREEDOM

What, then, determines the pace of liberalization? Here we explore the hypothesis that economic liberalization has been closely associated with political change. (See de Melo, Denizer, Gelb, and Tenev 1996 for further analysis of the determinants of economic liberalization.) This issue can be placed in the broader context of the relatively rich literature on political change and economic growth (see, for example, Olson 1993; Barro 1994).

Measures of political freedom are provided in Karatnycky (1995), a survey that has been published annually by Freedom House since 1973. The survey measures traditional political rights and civil liberties of Western democracies. The two components of the index are highly correlated and typically give very similar results when used separately in research (Helliwell 1994). Country rankings, based primarily on responses to a checklist of indicators, reflect the judgment of a project team that consults published materials as well as regional experts and human rights specialists. The survey is not a scorecard for governments, but rather an assessment of both governmental and nongovernmental factors that affect personal freedom. There is some evidence that these measures are robust. Following a conference in 1988 on measuring democracy, Inkeles (1990) concluded that the underlying measures of political freedom are common to all rating systems, even if specific indicators vary, and that there is high agreement among the results of alternative classifications.

The Spearman rank correlation between economic liberalization and political freedom for all twenty-six countries in our sample is 0.8. When the *RT* group is excluded, this figure is 0.91. The Pearson correlation coefficient for political freedom and the *CLI* is 0.75 and statistically very significant. A nonlinear relationship is shown for all twenty-six countries (figure 6). One explanation for this high correlation could be that both variables are strongly associated with an unidentified latent variable such as income. But Pearson and Spearman correlations between each of these variables and PPP per capita GDP in 1989 are far lower (0.39 for both in the case of liberalization and 0.47 and 0.48, respectively, in the case of political freedom) than those between the two variables themselves (0.75 and 0.79, respectively). Also, cross-country research has failed to establish a systematic relationship between political freedom and economic growth (Helliwell 1994). The lack of global relationships between political free-

Figure 6. *Political Freedom and Degree of Economic Liberalization in Twenty-Six Countries in Transition, 1989–94*

Cumulative liberalization index
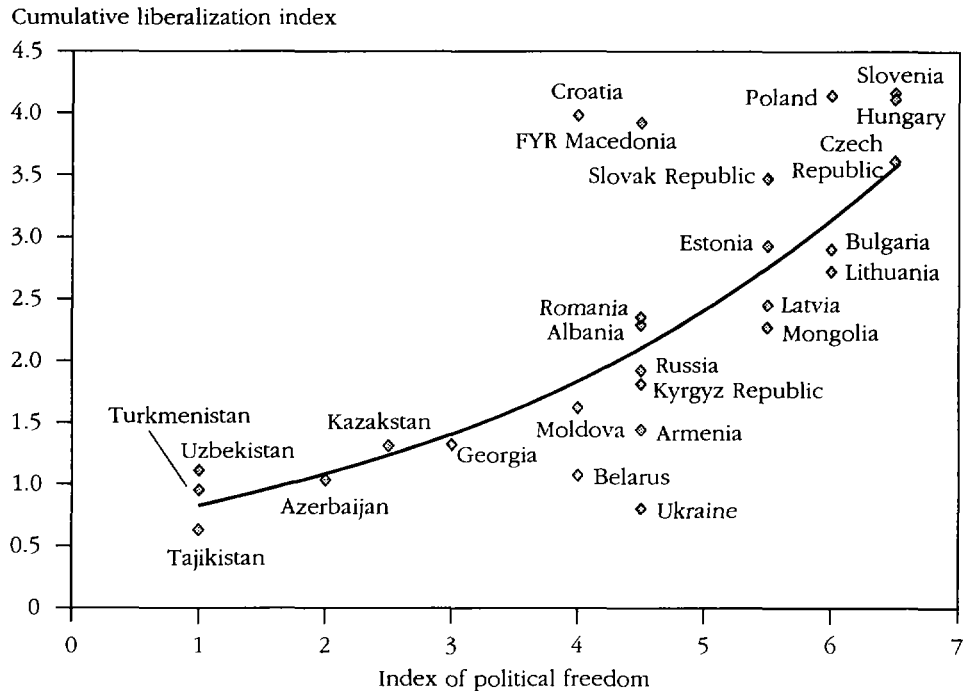
Note: See text for details about the cumulative liberalization index and the index of political freedom. The latter has been reversed for easier comparison with the former. The curve is given by $y = 0.6236e^{0.2683x}$, with $R^2 = 0.6453$.

Source: Authors' calculations based on Karatnycky (1995).

dom, on the one hand, and income and growth on the other suggests a need to look more closely at the relationship between political change and reform at the individual country level.

In countries of Central and Eastern Europe and the former Soviet republics where former leaders have held power continuously (such as Kazakstan, Turkmenistan, Ukraine, and Uzbekistan), reforms have been slow and driven largely by economic pressures arising from the breakup of the U.S.S.R. In countries where there was a clear break with the previous regime (Albania, the Czech Republic, Estonia, Latvia, Lithuania, and Poland), liberalization has been most radical, as reflected in a rapid change in the annual liberalization index from close to 0 to close to 1 during a phase of "extraordinary politics" (Balcerowicz 1993). So far, there has been little reversal of such movements to liberalize, even where "socialist" political parties have regained control (as in Estonia, Lithuania, and Poland). The lack of reversal is consistent with the view of Aslund (1994), who holds that democratization checks the power of the old elite.

Where power has been shared among a broad spectrum of political interests (Bulgaria, Russia), or where local governments have opposed reforms initiated

from the top (Russia), reforms have typically been halting and sometimes inconsistent, placing such countries in the intermediate category. In Bulgaria, for example, initial liberalization of internal and external markets, impelled by a particularly difficult macroeconomic situation, was not matched by corresponding progress in private sector entry. Moldova had a similar experience. In contrast, unlike most non-Baltic countries of the former Soviet republics, Russia and the Kyrgyz Republic made reforms in support of private sector entry that have moved almost as fast as other reforms. Mongolia also moved quickly on private sector entry, boasting the first comprehensive privatization program among intermediate reformers, even though its initial reforms of internal and external markets were halting.

Although the above discussion focuses on the effect of political freedom on economic reform, the direction of causality is actually two-way. Economic liberalization has powerful political implications. It is an essential step in breaking the power of established structures, especially line ministries that previously controlled industry and trade. This effect is potent even where political liberalization does not lead to the replacement of the political and managerial elite. With the exception of East Germany (where loyalty and competency tests were imposed) and Czechoslovakia (where a process of lustration was applied), leading communists and managers have typically been able to take advantage of political connections and technical expertise to redefine their role toward commerce and business management (see, for example, Rona-Tas 1994).

VIII. Conclusions and Implications for Policy Debates

Our analysis suggests that there are strong common patterns among countries at similar stages of reform. The common legacy and the associated changes resulting from initial disruptions in the socialist economic coordinating mechanisms and subsequent liberalization measures go a long way toward explaining the transition experience.

Reforms must be sustained to be effective. Thus their duration, as well as their intensity, is important. Analysis based on countries' cumulative liberalization experience provides a useful insight into the contraction-recovery cycle. Liberalization has also been an important element of stabilization policy, even though its initial impact entails a jump in prices and even though liberalization is by no means a sufficient condition for regaining price stability. The close relationship between economic liberalization and political freedom helps to explain why some countries moved very quickly on reforms while others did not.

Underlying sectoral and macroeconomic variables also evolve over the course of reform. In advanced reformers, liberalization permitted the reallocation of capital and labor from industry toward services, and the expansion of previously repressed sectors, together with export growth, has led the return to positive growth. The severe macroeconomic imbalances that developed in the final years of the Soviet republics left a costly legacy. But the main factor prolonging high

inflation has been continuing monetization of fiscal, and especially quasi-fiscal, deficits associated with attempts to maintain employment under the old system.

These findings bear on some recent policy debates. Portes (1994) and others argue that policies have overemphasized stabilization in relation to structural reform. It is hard to respond to this view generally when circumstances differ so much across countries (for example, between Ukraine and the Czech Republic). But such arguments seem to miss the strong complementarity between macroeconomic and microeconomic policy, and the apparent high costs of sustained inflation in the countries that are slow reformers.

The empirical analysis here supports Ickes and Ryterman (1993) and Balcerowicz and Gelb (1995), who argue that strong interactions between liberalization and stabilization are likely. It also supports the conclusions of Bruno and Easterly (1995), who find that in market economies neither effective markets nor renewed investment is possible with severe inflation and price instability. Thus stabilization becomes a priority for the resumption of growth. At the same time, it should be recognized that in transition countries stabilization is made more difficult because of the severe output losses during the early stages of liberalization. These reduce potential tax revenues and raise claims on fiscal resources to cushion the effects. Stabilization is also made more difficult because of limited external financing and the large depreciations in the exchange rate that accompany the early stages of liberalization.

A continuing debate has been whether or not countries should follow a "big bang" or a gradualist approach to reform. We make two points. First, the close relationship between economic and political liberalization suggests that it may be unrealistic to expect a given regime to perceive, or in fact to have, a very wide range of options. Second, the time profiles estimated here suggest that, to the extent that regimes do have options, rapid reform is preferable to slow reform, given a severe breakdown in the central planning apparatus. The status quo has not been a viable option for countries in Central and Eastern Europe and the former Soviet republics, and recorded inflation levels and output losses in most countries that managed to postpone adjustment are now far larger than those in the more advanced reformers.

Finally, some analysts have suggested that there is a "fiscal constraint" to rapid reform (Chadha and Coricelli 1994; Aghion and Blanchard 1994). They note that the fiscal costs of closing or restructuring state enterprises must be offset by revenue generated from new, private businesses. But taxing the private sector is difficult, and, anyway, taxes on emerging sectors must be low so as not to discourage growth. The budget balance therefore deteriorates as reforms are implemented more intensively. The cross-country comparisons that we carried out suggest a different conclusion. Fiscal revenue and expenditures have tended to remain high, in relation to GDP, in the advanced reformers, and fiscal deficits have been lower than those in the slower reformers. Even if there are reasons—cultural, institutional, or structural—for the stronger fiscal position of advanced reformers, there is no convincing evidence that a slower pace of reform has

strengthened the fiscal position of intermediate reformers. It is certainly possible, for example, that the institutional infrastructure (tax code, tax administration, expenditure control) and general conditions of societal order and compliance are stronger in advanced reformers. The failure of slow reformers to maintain fiscal balance is highlighted by the fact that their consolidated fiscal deficits, including central bank credit subsidies, have often been larger than those of intermediate reformers. As suggested earlier, the lack of adjustment by enterprises in response to structural shifts in demand may generate negative value added for many of them and therefore no taxable surplus.

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Hungary's Bankruptcy Experience, 1992–93

Cheryl W. Gray, Sabine Schlorke, and Miklos Szanyi

Policymakers working on enterprise restructuring should take a close look at Hungary's experience with bankruptcy reform since 1992. This article provides detailed data on a randomly selected stratified sample of actual cases filed in the first two years after the enactment of the law. These data are supplemented with information obtained from interviews with judges, liquidators, and firms involved in the bankruptcy process to give an overall picture of the process in the first two years of its implementation. The bankruptcy process in Hungary has indisputably spurred institution building in the courts, the trustee profession, and the banks. It may also have succeeded broadly in separating viable from unviable firms. It did little, however, to further either deep restructuring or the exit of ailing firms. The changes in incentives and institutions that are needed to make bankruptcy work in transition economies invariably take time. Hungary's initiative, albeit imperfect, was a bold start toward reform.

As policymakers in both developing economies and economies in transition look for policies and processes to spur enterprise restructuring, they should take a close look at Hungary's experience with bankruptcy reform since 1992. Here we use the term "bankruptcy" for the entire process, and "reorganization" and "liquidation" for the two specific procedures provided in the Hungarian law. Although other countries have adopted innovative restructuring processes (see Gray and Holle forthcoming on the Polish bank-led conciliation process), Hungary's experience with formal bankruptcy law is indeed unique in the postsocialist world. Hungary adopted a tough new bankruptcy law in late 1991 that took effect January 1, 1992. It required managers of all firms with arrears of more than ninety days to file for either reorganization or liquidation within eight days (the so-called automatic trigger) and provided a rather sympathetic framework for them to do so. The law immediately resulted in a wave of filings, with some 3,500 filings in April 1992 alone (after the ninety-day grace period covered by the law). Over 22,000 cases were filed in 1992–93, a level far beyond the expectations of policymakers when the law was adopted (see table 1).

Although the level of activity has been enormous, detailed information on how the bankruptcy process has actually worked in Hungary has been scarce.

Table 1. *Reorganization and Liquidation Processes of Hungarian Firms, January 1992 through December 1993*

Indicator	Reorganization	Liquidation
Number of filings	5,156	17,133
Number of firms		
State-owned enterprises	429	1,820
Cooperatives	965	2,768
Business entities	3,762	12,545
Limited-liability firms	2,959	8,927
Number of employees (percentage of firms)		
Over 300	6	—
51–300	24	—
50 or fewer	70	—
Status of cases as of December 31, 1993 (number of firms)		
Closed	4,627	a
With agreement	1,250	
Reversion to liquidation	1,377	
Administrative completion	2,000	
Pending	529	

— Not available.

a. Over 10,000 liquidation cases were completed by the courts in 1992 and 1993, but these included cases filed in earlier years under the previous law. Furthermore, over three-fourths of the completed cases were "administrative completions," that is, cases withdrawn or rejected on administrative grounds. Only a very small number of the 17,133 cases filed in 1992 and 1993 were completed by the end of 1993.

Source: Government of Hungary, Ministry of Finance.

Many views—both positive and negative—have been put forward regarding the impact of the law on enterprise restructuring in particular and economic growth more generally, but they have been supported by very limited reliable data. (For a negative view, see Bonin and Schaffer 1994.) This article helps to fill this information vacuum by providing detailed data on a randomly selected stratified sample of actual cases filed in the first two years following the enactment of the law. These data are supplemented with information obtained from numerous interviews with judges, liquidators, and firms involved in the bankruptcy process to give an overall picture of the process in the first two years of its implementation.

Bankruptcy law plays at least three important roles in market economies. First, it provides ailing firms with an orderly means of exit. Second, it shifts control rights over assets toward creditors and helps to reallocate assets to better uses through a combination of restructuring and liquidation. Third, it promotes the flow of credit in the economy by protecting creditors and serving as a final stage of debt collection. The first two roles work together: the threat of exit spurs restructuring, and the impossibility of restructuring spurs exit. The bankruptcy process should ideally be able to discriminate between unviable firms

and potentially viable ones that can be saved through restructuring. For enterprises able to cover operating costs out of current revenues but unable to cover debt service, reorganization provides an avenue to restructure debt burdens and thus continue in operation. It may promote such restructuring formally, as in the Hungarian reorganization procedure, or through informal debtor-creditor workouts undertaken to avoid formal bankruptcy. Firms unable to cover even operating costs are clear candidates for exit unless they can be fundamentally restructured to regain viability. The role of bankruptcy law in altering control rights over a firm is the subject of much recent literature in corporate finance. For further discussion and references, see Baer and Gray (1996).

In their emphasis on preserving jobs and production, policymakers in many transitional countries focus on these first two roles for bankruptcy law, as we do in this article. However, the third role is at least as important for economic growth. A well-designed bankruptcy process takes control over financially distressed firms before all assets have been misused or dissipated. It also gives creditors the information and power to use the remaining assets to maximize the potential for debt recovery, either by improving the firm's performance through reorganization or by liquidating the firm and satisfying creditors' claims to the extent possible out of sale proceeds. By giving creditors the confidence that debts can be collected, bankruptcy processes (and collateral laws prior to bankruptcy) facilitate the role of banks and other creditors in funding and monitoring investment in an economy and in exerting influence over enterprise managers. Without the ability to collect debts, banks will refuse to lend at all or will lend only to those clients they know well—and thereby become peripheral players in both resource allocation and corporate governance—or they will turn to the state for support when loans turn bad. Thus bankruptcy legislation is an important complement to, *not* a substitute for, disciplined macroeconomic policies and privatization and the hard budget constraints and corporate governance possibilities they create.

Considering these various roles of bankruptcy law, the major questions to be addressed include the following:

- What types of firms entered reorganization or liquidation, or both, in Hungary in 1992 and 1993, and why?
- What were the roles of the various actors in these processes (that is, debtor managers and owners, creditors, judges, liquidators/trustees), and why?
- How cumbersome were these processes in practice?
- What have been the direct effects of reorganization on the debt structure and operations of firms?
- What have been the direct effects of liquidation and reorganization on enterprise exit, privatization, and institution building?
- Has the process served reasonably well as a debt collection mechanism for creditors?
- How can the bankruptcy process be improved?

The bankruptcy process in Hungary has indisputably spurred institution building in the courts, the trustee profession, and the banks. It may also have succeeded in broadly separating viable from unviable firms. It did little, however, to further either deep restructuring or the exit of ailing firms. The changes in incentives and institutions that are needed to make bankruptcy work in transition economies invariably take time. Hungary's initiative, albeit imperfect, was a bold start toward reform.

I. THE LEGAL FRAMEWORK FOR HUNGARIAN BANKRUPTCY

The Hungarian bankruptcy law of 1991 replaced legislation adopted in 1986 and provided Hungary for the first time with a modern legal framework, quite similar in structure to the U.S. bankruptcy regime (albeit with the addition of the controversial automatic trigger). Debtor firms could file for either reorganization or liquidation, but creditors could file for liquidation only. If debtors filed for reorganization, incumbent management could stay in place, and the firm received automatic relief from debt service and asset foreclosures for three months (with one-month optional extension). During this three-month period, debtor management was supposed to develop a reorganization plan and present it to creditors. The creditors' unanimous approval was required for the plan to be adopted; otherwise the case reverted automatically to liquidation. A firm with a successful plan could not file again for bankruptcy for at least three years. Trustees' and creditors' committees were not required in reorganization cases but could be organized at the discretion of creditors.

The liquidation process provided by the 1991 law was also in line with international norms. It provided for a liquidator to be appointed once the court reviewed and decided to proceed with a filed case. The liquidator was supposed to notify creditors, draw up a list of assets, sell the assets, and divide the proceeds among creditors in order of priority. (Liquidation costs came first, followed by creditors secured by mortgage, other creditors, and equity holders, in that order. Liens other than mortgages on real property had no priority over unsecured credit.) The entire process was supposed to be completed within two years. The law set compensation levels for liquidators and trustees, and regulations adopted concurrently with the law provided an annual licensing procedure for liquidators, setting out minimum capital requirements and professional qualifications.

Numerous important changes were made to the law in September 1993, drawing ostensibly from the first one and a half years of experience with the 1991 law. The unanimous creditor approval requirement was considered too tough, so it was replaced by a requirement of creditor approval by at least one-half of creditors representing two-thirds in value of outstanding claims. The automatic three-month stay on debt service was considered too generous and easy to abuse, and it was replaced by a discretionary stay that required the same level of creditor approval within fifteen days from the date of filing. This new creditor approval requirement made it difficult, if not impossible, in most cases for debtors

to obtain such relief from debt service, because creditors would not be likely to approve such a moratorium without seeing a viable reorganization plan. Liquidators' compensation was considered too low and was increased. To stem the unanticipated flood of cases, both the automatic trigger and the automatic reversion of failed reorganizations to liquidation were eliminated. Finally, the appointment of a trustee was made mandatory in all reorganization cases.

After the passage of the 1993 amendments, the number of reorganization cases declined dramatically, to a level of only about five cases a month by the end of 1994 for several likely reasons. First, the 1993 amendment removed both powerful "carrots" (the automatic stay) and powerful "sticks" (the automatic trigger), and the trustee requirement increased the costs and introduced potentially undesired outside controls into the process. Liquidators/trustees are licensed by the state and are not always considered by creditors to represent their best interests. Furthermore, at the end of 1993 a new out-of-court workout process, called debtor consolidation, was introduced in Hungary. Although description of this process is beyond the bounds of this article, suffice it to say that many debtors and creditors may have seen debtor consolidation as a substitute for reorganization under the bankruptcy law (see Szanyi forthcoming or Baer and Gray 1996). Finally, the general economic conditions of Hungary improved in 1994, and many of the worst firms may well have already been included in the flood of cases in 1992–93.

II. THE BANKRUPTCY SAMPLE

To gain insight into many of the questions raised earlier, we undertook a survey of 117 bankruptcy cases filed between April 1992 and September 1993. All were covered by the unamended 1991 law. They were filed in one of three courts—Budapest (where approximately one-third of all Hungarian cases were filed in 1992–93), Pest County, or Debrecen (a more rural location). The sample was limited to manufacturing firms and was stratified both by process and by size (see table 2). With regard to process, the sample was structured to favor completed reorganizations (63 cases) while still having a substantial number of liquidations, whether cases transferred from reorganization (28) or filed as liq-

Table 2. *The Sample of Firms in Bankruptcy, by Process and Size of Firm, Hungary, 1992*
(number of firms)

Process	Large firms	Small firms	Total
Completed reorganization agreements	36	27	63
Transfers from reorganization to liquidation	14	14	28
Liquidation filings	10	12	22
Withdrawals	0	4	4
Total	60	57	117

Source: Authors' calculations.

uidations (22). Four cases were filed as reorganizations but withdrawn before completion.

With regard to size, the sample was stratified to include both small and large firms on a roughly equal basis (57 small firms and 60 large firms). Large firms were defined either as firms taken from a list of Hungary's 603 largest loss-making firms in 1992 or as firms not on that list but with assets of more than 100 million forint (approximately US$1.25 million in 1992). We wanted to sample heavily from this list, which represented Hungary's biggest problem firms, in order to get a sense of how the process addressed these problems. If we had not stratified the sample to favor large firms, a totally random sample would have contained overwhelmingly small firms. Because the sample of large firms was taken from the list of loss makers, the large firms in our study are likely to have had worse average financial performance than a random sample of large firms that filed for bankruptcy. Actual cases were chosen at random, subject to these stratification criteria and to the willingness and ability of firms to participate. (Approximately 40 percent of firms approached for the study agreed to participate.) Data for each firm were collected both from court files (on average about one-quarter of all data) and from interviews with managers or liquidators, or both.

Sector and Ownership

Table 3 shows the breakdown in the sample by sector and by ownership, two variables not controlled in the stratification. The sectoral distribution is broad, with somewhat heavy representation by firms producing machinery and equipment. Ownership patterns support the prior expectation that larger firms tended to be state owned and smaller firms tended to be private. Table 4 shows the mean values for basic indicators for large and small firms at the time of filing for bankruptcy. All financial data cited in this study should be regarded as approximations. Data on assets, liabilities (particularly residual equity), and income are all questionable, given the enormous deficiencies in accounting in the transition environment. However, because the extent of accounting deficiencies within individual firms is unlikely to be correlated with other independent variables used in this analysis, we believe that such accounting deficiencies are unlikely to seriously compromise the overall findings of the study (which depend on relative comparisons among different categories of firms rather than absolute magnitudes).

Large and small firms had on average 625 and 37 employees, respectively (table 4). Although their overall level of debt (both long- and short-term) as a share of the reported book value of assets was similar and on average very high (146 percent), large firms tended to have a much larger share of bank debt and a somewhat lower share of debt to suppliers and government. The firms in our sample were worse-off financially than the average firm in bankruptcy, as is evident from a comparison of these numbers with data on bankruptcy cases collected by the Hungarian Central Statistical Office (CSO). According to CSO

Table 3. *Sectoral Distribution and Type of Ownership of Sample Firms,*
Hungary, 1992
(number of firms)

Firm distribution	Large firms	Small firms	Total
Sector			
Transport equipment	0	9	9
Electronics and medical equipment	2	1	3
Machinery and equipment	19	19	38
Metals, plastics, and chemicals	14	9	23
Paper, wood, and printing products	5	7	12
Textiles, apparel, and leather	12	7	19
Tobacco and food	8	5	13
Total	60	57	117
Firm ownership			
State agency	29	6	35
State	13	7	20
Majority state-owned	1	2	3
Majority privatized	2	0	2
Fully privatized	4	0	4
Private, established domestically	4	33	37
Private, established as a joint venture	3	4	7
Private, established by foreign parties	1	0	1
Cooperative	2	4	6
Other	1	1	2
Total	60	57	117

Source: Authors' calculations.

Table 4. *Mean Values of Indicators for the Sample Firms, Hungary, 1992–93*

Indicator	Large firms	Small firms	Total
Number of employees	625	37	344
Total assets (book value) (millions of forints)	1,142	88	605
Total debt as percentage of total assets	145	147	146
Bank debt as a percentage of total assets	58	12	34
Payables to suppliers as a percentage of total assets	43	65	54
Government debt as a percentage of total assets	9	19	14
After-tax profit (loss) as a percentage of total assets	−33	−9	−21

Note: The values are for firms filing for reorganization or liquidation in the most recent fiscal year prior to filing (in most cases 1991). The data are for the 104 to 111 firms with valid answers out of the 117 firms in the sample described in the text. The sample contains 60 large firms and 57 small firms.
Source: Authors' calculations.

data, the average debt-asset ratio of firms that filed for reorganization in 1992 was 0.57, well below the average for firms in our sample.[1] Both large and small firms in our sample had a large residual of unclassified debt. In addition to credit from other parties (for example, owners or affiliated firms), some of this unclassified debt could well be misclassified suppliers' credits—for example, arrears to utilities. Little of it is likely to be bank credit.

1. We are indebted to Mark Schaffer for providing us with the CSO data.

Figure 1. *Reasons for Financial Distress in Sample Firms, Hungary, 1992–93*

Percentage of sample firms
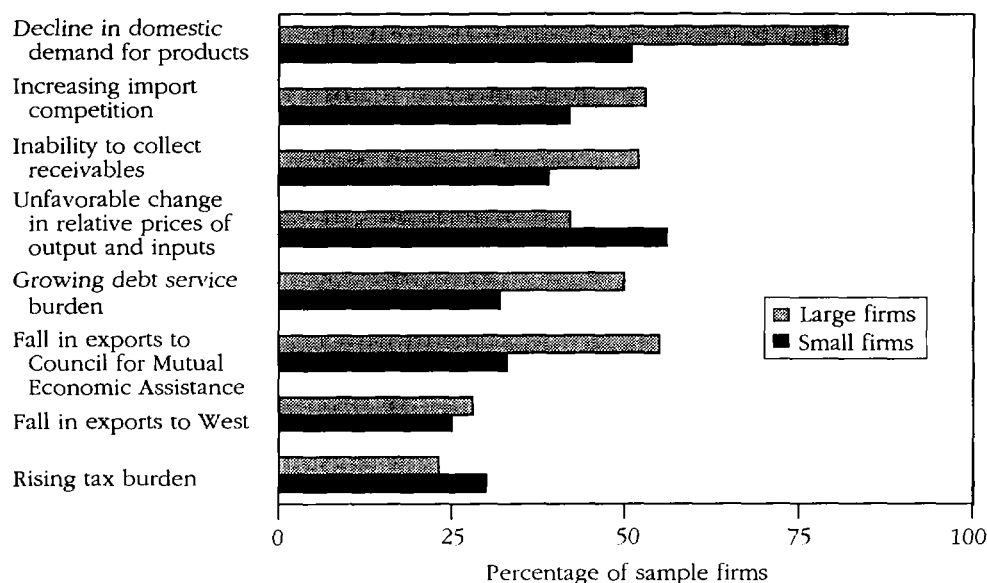
Note: The data are for 117 manufacturing firms in bankruptcy in the sample described in the text. The sample contains 60 large firms and 57 small firms.

Source: Authors' calculations.

Reasons for Financial Distress

Reported external reasons for prebankruptcy financial distress in small and large firms are shown in figure 1, and summarize both prebankruptcy numerical data and subjective judgments reported in the questionnaire. Although firms report a wide range of external reasons for financial distress, decline in domestic demand for the products the firms produce appears to have been more important for large firms, which is not surprising given that many were state-owned firms producing goods that were obsolete or uncompetitive in the transition environment. Unfavorable relative changes in output and input prices and high tax burdens appear to be somewhat more important for smaller (mostly private) firms. In contrast with a common impression in Hungary, the decline in exports to the Council on Mutual Economic Assistance (CMEA), although important for both small and large firms, was by no means the primary reason for financial distress in this sample of firms. Of course, internal reasons for financial distress, such as weak management or poor accounting, are also likely to be very important in many cases but were not readily measurable in this survey.

III. THE BANKRUPTCY PROCESS IN ACTION

The enormous number of bankruptcy filings in April 1992 is a clear indication of the effect of the automatic trigger that was introduced in the 1991 law.

Table 5. *Financial Distress in the Sample Firms at the Time of Filing for Bankruptcy, Hungary, 1992*
(percentage of total assets)

Indicator and process	Large firms	Small firms
Debt		
Completed reorganization agreements	70	104
Transfers from reorganization to liquidation	302	245
Liquidation filings	188	148
After-tax profits		
Completed reorganization agreements	–23	–3
Transfers from reorganization to liquidation	–54	–25
Liquidation filings	–34	–26

Source: Authors' calculations.

The survey highlights this effect: more than 95 percent of the firms in the sample noted the trigger as the immediate impetus for filing. Only six firms, all of them liquidation cases, did not cite the automatic trigger as the impetus for filing.[2] The main other reason cited was the creditors' attempt or threat to foreclose on collateral or otherwise collect debt. A total of sixteen firms cited this second reason (ten of which also cited the automatic trigger). Under the trigger, a firm could file for either reorganization or liquidation, and one goal of the survey was to find out the differences between firms taking these various routes (and those succeeding or failing at reorganization).

Table 5 shows key financial indicators at the time of filing for three categories of firms—those that exited the reorganization process with successful agreements, those for which reorganization cases were transformed into liquidations, and those that filed initially as liquidations. These figures indicate that the outcomes of the bankruptcy regime appear to have had some degree of rationality even as early as 1992. The debtors in the transformed cases were in much greater debt to all types of creditors than the debtors with accepted reorganization plans. The former also had much greater losses than the latter. Furthermore, debtors in transformed cases not only had fewer assets overall than debtors in firms with accepted reorganizations, but a higher percentage of their assets were inventories and receivables. The latter, in contrast, had more cash, real estate, and machinery and equipment—assets that are more likely to have a positive market value.

These data suggest that the reorganization process did have some success in separating viable from unviable firms. Although this is undoubtedly an important conclusion, our impressions of the process gathered from outside interviews of managers and liquidators from 1992 to 1994 may temper it. These impressions suggest two other possible reasons for the differences between accepted and rejected reorganizations—both of which infer that the latter were perhaps never intended to succeed. First, the 1991 law quickly and dramatically altered both the legal framework for bankruptcy and the responsibilities placed

2. These data are available from the authors.

on managers of bankrupt firms. It is very likely that many managers did not immediately understand the new law and its requirements, and thus filed for reorganization when they should have filed for liquidation. Second, it is widely believed in Hungary that some managers of state-owned firms spun off, or otherwise diverted, valuable state-owned assets, whether fixed assets, labor, or intangibles (such as contracts and goodwill), to subsidiaries or private firms. Furthermore, owners or managers of private firms can also direct valuable assets to other uses (or foreign bank accounts), leaving only shell firms to enter either reorganization or liquidation, or both. In an environment with poor information and underdeveloped watchdog institutions, it is exceedingly difficult to prevent such activity.

The practice of redirecting valuable assets or income flows is not unique to Hungary. Similar value stripping is widely reported to occur in Bulgaria, Ukraine, and other transitional economies that have been slow to privatize state assets. It can also be widespread in privatized firms if nonmanagerial shareholders have little ability to monitor managerial behavior (see World Bank 1996). Although the extent of value diversion is unknown and impossible to measure, it is generally accepted that it has occurred on a significant scale in Hungary. For in-depth discussion of the recombination of assets in Hungary, see Stark (1996). The survey attempted to get at the issue of prebankruptcy asset diversion by asking numerous and varied questions on the topic. Only a small number of firms reported major asset transfers in the three years prior to filing. However, this is a variable that managers may choose to hide and that liquidators may not have information about, and thus significant underreporting is likely. Many of the reorganization filings may have been undertaken by managers who had previously diverted valuable assets and were biding their time before liquidation. These managers could have filed directly for liquidation, but filing for reorganization first resulted in an automatic three-month delay. Such delay might have been helpful, for example, in avoiding a subsequent investigation of prior asset transfers by liquidators, who have the legal right to void transactions occurring within one year of liquidation filing. In sum, although some of the transformed cases may represent serious yet ultimately unsuccessful attempts to restructure, we believe that many of the cases represent either managerial misunderstanding or prebankruptcy value diversion.

Turning to liquidations, table 5 shows that firms filing for liquidation also had higher debt levels and greater losses than firms with accepted reorganization agreements, and their assets were also more concentrated in receivables and inventories. Again, the process appears to have pushed the worst firms into liquidation, although again prefiling value diversion in both public and private firms probably played some role in creating the financial distress in certain cases.

The Completion Time for Bankruptcy Cases

The flood of bankruptcy cases filed in 1992 and 1993 undoubtedly put a strain on Hungary's judicial institutions. The Budapest court in 1992 had only

eight bankruptcy judges handling more than 15,000 cases. It is perhaps somewhat surprising, therefore, that over 60 percent of the reorganization cases filed in 1992 were completed the same year, and that over 90 percent of the cases filed in 1992 and 1993 were completed by the end of 1993 (see table 1 earlier). Survey data on the average time required for various stages of the reorganization process further support the conclusion that the process was not unduly slow (see table 6). The average time required for an agreement to be finalized was approximately eight months for both large and small firms. On average the debtors presented their reorganization proposals about six weeks after the court's decision to proceed, or about eighteen weeks after filing. The period of negotiation between the presentation of the first plan and the final resolution of the reorganization cases averaged another four months. Unsuccessful cases (particularly those involving large firms) took somewhat longer than successful ones, although virtually all cases were completed within one year of filing.

Reorganization cases could proceed quite quickly, despite their huge numbers, because the level of involvement of courts and trustees was low. The judge's approval depended in most cases on the judge's finding that required information had been submitted with the filing. Once a judge approved a case to pro-

Table 6. *Time Requirements for Reorganization Cases, Hungary, 1992–93*
(average number of days)

Process	Completed reorganizations		Cases transferred from reorganization to liquidation		All	
	Large firms	Small firms	Large firms	Small firms	Large firms	Small firms
From filing to the court decision to proceed with the case	80	66	107	104	87	79
From court decision to proceed with the case to the submission of the first reorganization plan	39	48	55	30	43	42
From submission of the first reorganization plan to the final court decision	119	110	152	127	126	114
Total[a]	238	224	314	261	256	235

Note: The data are for ninety of the ninety-one reorganization cases in the sample with valid answers.
a. The total number is not an exact measure of the average duration of the bankruptcy process because the underlying number of cases changes from subperiod to subperiod.
Source: Authors' calculations.

ceed (which took on average about three months because of the courts' overload), the judge had little substantive involvement. The debtor and its creditors managed the process, and in this decentralized mode the process could proceed quite rapidly. In *none* of the ninety-five reorganization cases in the sample did the parties choose to involve a trustee in the process. This could be because of the extra expense involved (that is, the trustee fees), combined with the fact that trustees had to be selected from a preapproved list that might not have corresponded to the parties the creditors trusted. It could also simply reflect the relative passivity of creditors during this period (see discussion in the next subsection). This lack of demand for trustees brings into question the reasonableness of the 1993 amendment, which requires a trustee in bankruptcy cases.

The quickness of the reorganization process was not, however, characteristic of the liquidation cases in the sample (see table 7). Only one of the fifty liquidation cases in the sample had been completed by late 1994—that is, within the two years required by law. The average time between filing and the first disposition of assets was about thirteen months, and even this period is significantly underestimated because only about one-half of the firms had sold *any* assets when the survey was conducted.

A major cause for delay in the liquidation process, particularly in cases originally filed as liquidations, was the court's slowness in appointing a liquidator.

Table 7. *Time Requirements for Liquidation Cases, Hungary, 1992–93*
(average number of days)

Process	Cases transferred from reorganization to liquidation		Cases filed as liquidations		All	
	Large firms	Small firms	Large firms	Small firms	Large firms	Small firms
From filing or transfer from reorganization to the appointment of a liquidator	46	179	350	225	183	200
From the appointment of a liquidator to the formal notification of creditors	14	37	35	35	24	36
From the formal notification of creditors to the first disposition of assets	200	133	304	134	244	133
Total[a]	260	349	689	394	451	369

Note: The data are for forty-eight of the fifty liquidation cases in the sample with valid answers.

a. The total number is not an exact measure of the average duration of the liquidation process because the underlying number of cases changes from subperiod to subperiod.

Source: Authors' calculations.

This step alone took more than seven months for small cases filed as liquidations and almost a year for large cases.[3] Although this delay is perhaps not surprising, given the flood of over 10,000 liquidation cases in 1992 alone, it almost certainly had serious costs in some cases because of the vacuum of oversight and the opportunities for further asset diversion during that interim period.

It is interesting to note that courts took far less time to appoint liquidators in cases transformed from reorganization (particularly those with large firms) than in cases originally filed as liquidations, possibly because the previous exposure to those firms in the reorganization phase gave the courts (and the liquidators) the information and incentive to move quickly once the reorganization had failed. Indeed, in the case of large firms the total elapsed time between initial filing (for reorganization or liquidation) and the first disposition of assets in a liquidation was no longer for those firms that went through reorganization than for those that did not.

Who Controls Reorganization and Liquidation

A key to understanding the likely impact of bankruptcy in Hungary is to understand who controls reorganization and liquidation. The greater the control wielded by one party (be it debtor or creditor) over a process, the more likely that process is to benefit that party. In mature market economies, where information is relatively plentiful and open and where judicial processes are relatively well developed, bankruptcy is typically a fine balancing act between numerous competing interests, all of them quite actively defending their own interests. In transition economies, however, the situation is quite different. Information is far more costly, and judicial processes (and even notions of due process and fiduciary responsibility) are far less developed. As a result, some parties may have neither the means nor the power to defend their interests effectively. Furthermore, some of the parties to bankruptcy proceedings may not have strong incentives to collect debts aggressively. For example, state-owned firms or state-owned banks may be more inclined to turn to the state for compensation than to pursue debt collection through official legal means. This is particularly true if there is a history of repeated bank recapitalizations, as in Hungary (Baer and Gray 1996).

Figure 2 presents indicators of the relative participation of various parties in reorganization and liquidation. It is clear from these data that managers tended to be most powerful in reorganization proceedings, generally controlling the process, and that liquidators had virtually total control in liquidation cases (with managers still often in active roles). Banks and other creditors were sometimes active, sometimes passive, but virtually never in control of either process. Interestingly, banks do not appear to have been significantly more active than other types of creditors, whether trade creditors or government creditors. Another more general indicator of this relative lack of involvement of banks (particu-

3. This finding is probably somewhat biased by the large share of sample firms handled by the Budapest Court. This court was thought to be the most overloaded and thus the slowest in the country at that time.

Figure 2. *Distribution of Control of the Bankruptcy Process for Large Firms in the Sample, Hungary, 1992–93*
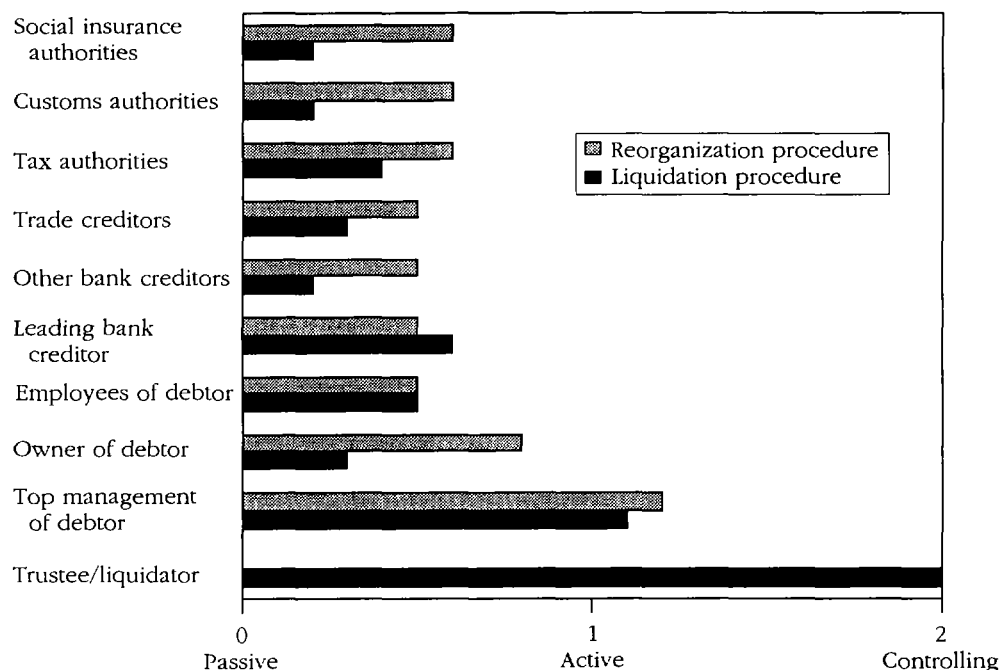
Note: The data are for the sixty large manufacturing firms in bankruptcy in the sample described in the text.

Source: Authors' calculations.

larly compared with their very active role in bankruptcies in mature market economies) is the very low percentage of cases (approximately 1.5) filed by banks through 1993 (table 8).

Several factors may explain the relative inactivity of creditors, particularly banks. First, creditors in Hungary, as in other transition economies, may lack the information and expertise to understand what is at stake and to actively oversee debtor management or liquidators, or both. Watchdog institutions, which can help provide information to creditors—such as accountants, credit rating services, securities regulators, or the press—are in their infancy in transition economies. (For further discussion of the institutions needed to support a market economy, and how they develop in transition settings, see World Bank 1996.) Our bankruptcy cases, all of which were filed in 1992, were some of the first ones.

Second, creditors may lack the incentive to be strong debt collectors, particularly if they are state owned (as all the large banks have been up to 1995 in Hungary) and perhaps expect future state assistance (as Hungarian banks repeatedly received between 1991 and 1995). Third, creditors often express doubt to this day that they can recover anything in the process. Although this is under-

Table 8. *Agencies Filing Liquidation Cases in Hungary*

Agency	Petitions filed (percentage of total)
Bank creditors	1.5
Government creditors[a]	13.0
Debtor firms	67.5
Others[b]	18.0

Note: The data are for all liquidation cases filed in Hungary in 1992–93.
a. Tax, social security, and customs offices.
b. Includes trade creditors, liquidators, and conversions from reorganization proceedings.
Source: Government of Hungary, Ministry of Finance.

standable in the case of liquidation, given the power of liquidators to prolong the process and the priority given to liquidation costs over creditors' claims (discussed later), it is not clear why the reorganization process is seen as so unfavorable to creditors. Indeed, under the legislation in place in 1992 any creditor had the power to force firms into liquidation by refusing to agree to the reorganization plan (given the unanimous agreement requirement and the automatic reversion to liquidation), and thus on paper the power of creditors was very strong. This strong formal power lends further credence to the importance of the first two explanations.

The Direct Effects of Reorganization

The fundamental challenge of transition is enterprise restructuring, and the core question in our research is what effect the Hungarian bankruptcy process has had on restructuring in Hungarian firms. The effects on restructuring can be either direct or indirect, or both. Indirectly, the mere fact that bankruptcy became so widespread in 1992 probably spurred greater financial discipline in all firms. Although evidence clearly points to improvements in financial discipline, perhaps for this as well as other reasons, we did not attempt to assess these indirect effects (see, for example, Szanyi forthcoming). We did, however, attempt to assess the direct effects of the process on restructuring by studying the contents of reorganization plans and the changes in firm behavior and performance during and after bankruptcy (whether reorganization or liquidation).

FINANCIAL REORGANIZATION. The contents of the financial reorganization plans of the ninety-one cases of successful and unsuccessful (that is, transformed) reorganizations in the sample are summarized in figure 3. The data point to the relatively unsophisticated nature of the final plans. The overwhelming majority of accepted reorganization plans provided for either an extension of loan maturity (generally of one-half to two years) or a write-off of debt principal, including capitalized interest arrears (of on average about 13 percent in the case of bank debt and 20 to 30 percent in the case of debts to government and suppliers). About one-third of accepted plans provided for some partial immediate debt

Figure 3. *Contents of Reorganization Agreements of Sample Firms: Financial Restrucuring of Firms, Hungary, 1992–93*

Percentage of restructuring plans with a provision
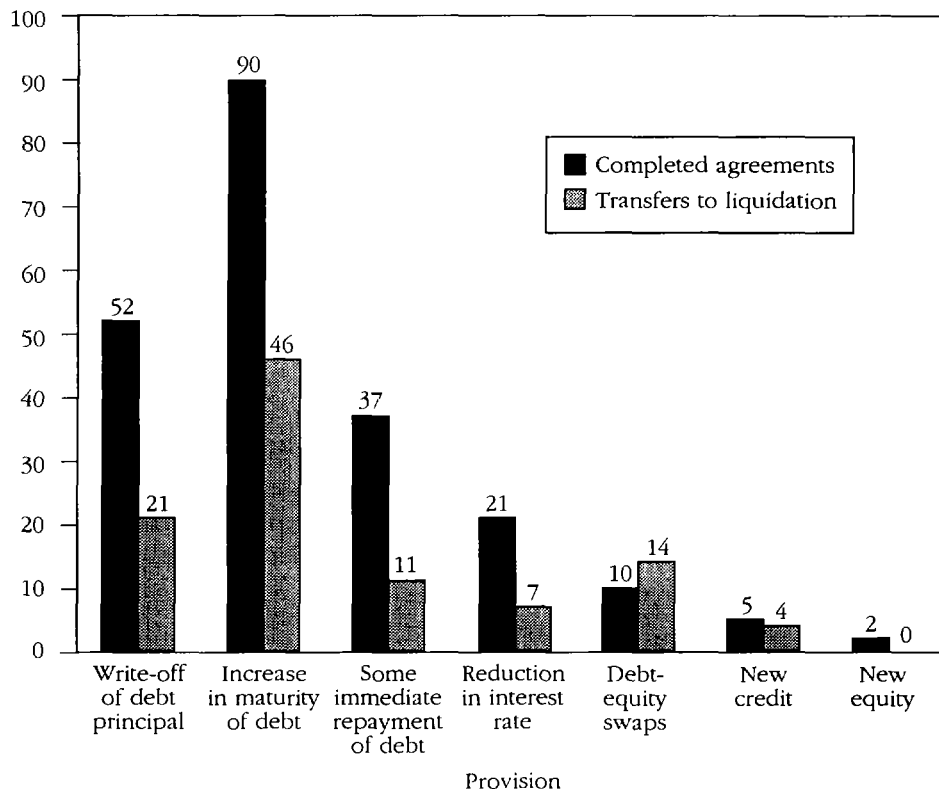
Note: The data are for ninety-one cases of successful (completed agreements) and unsuccessful (transfers to liquidation) manufacturing firms in reorganization in the sample described in the text.
   Source: Authors' calculations.

repayment (of widely varying percentage amounts), and 21 percent provided for a reduction in interest rates (figure 3). Six of the sixty-three accepted agreements provided for debt-equity swaps by one or more types of creditors, although there is evidence that most were never implemented. Only three of the sixty-three plans provided for new credit, and only one for new equity.[4] Overall, agreements for small firms contained fewer concessions than agreements for large firms, perhaps not surprising given small firms' less onerous financial condition at the time of filing, and probably their lower bargaining power as well.

4. The absence of new credit is not surprising, given that the Hungarian law gives no priority to such financing. In contrast, financing during reorganization is granted top priority under the U.S. Chapter 11 procedure. However, the situation may not be entirely analogous, as there are much tighter controls on asset disposition and cash flow under Chapter 11—making cash harder to come by—than in the Hungarian case.

It is clear from figure 3 that proposed plans in unsuccessful reorganizations (that is, those transformed into liquidations) contained fewer provisions overall than plans in successful cases. However, if a provision was included, its magnitude was often greater than in the case of successful agreements. The paucity of provisions further supports the conclusion discussed earlier that many of these cases were not filed with the intention to succeed in the first place. The relatively higher magnitudes of provisions when they *were* proposed may point to the likely absence of serious negotiations in many rejected cases.

OPERATIONAL REORGANIZATION. Most of the firms in the survey agreed or undertook steps to downsize during the reorganization period, as indicated in figure 4. Whether or not formally included in the reorganization plan, almost two-thirds of all firms with successful plans agreed or undertook steps to reduce employment (typically by one-quarter to one-third) and almost one-third agreed

Figure 4. *Operational Restructuring of Sample Firms during Restructuring, Hungary, 1992–93*
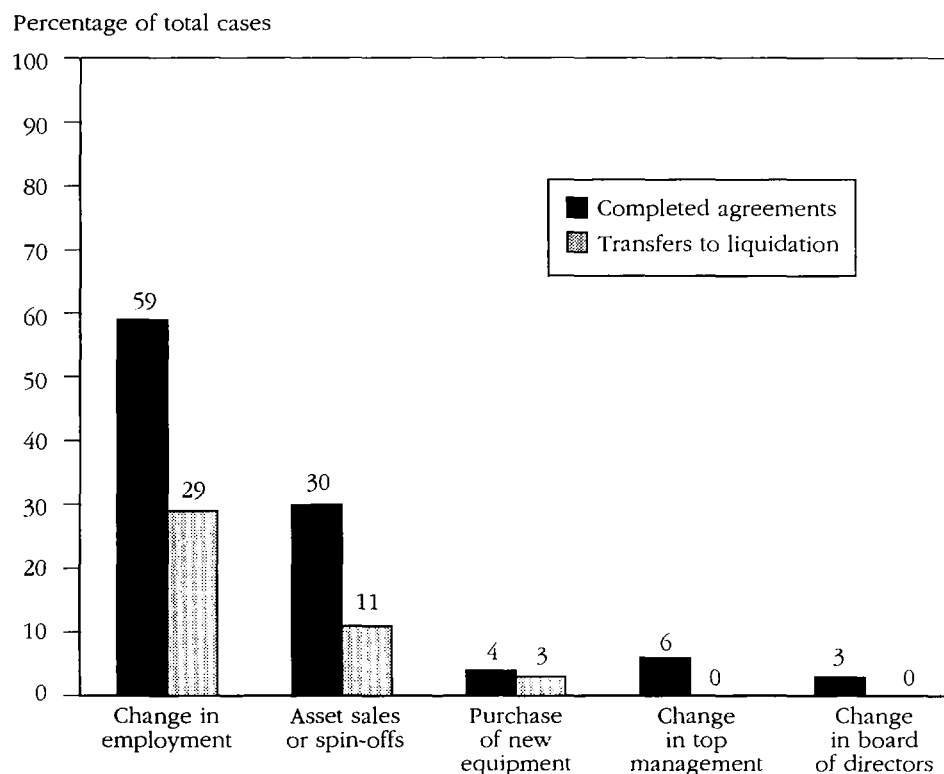
Percentage of total cases

Note: The data are for ninety-one cases of successful (completed agreements) and unsuccessful (transfers to liquidation) manufacturing firms in reorganization in the sample described in the text. *Source:* Authors' calculations.

or undertook steps to sell assets or parts of the firm. The bankruptcy filing was not necessarily the primary reason for such downsizing. Many of the firms were already downsizing before bankruptcy and may well have continued in any case. At a minimum, however, it is clear that bankruptcy did not provide a safety valve to stop downsizing. Nor did it spur management change. Only 6 percent of firms with successful plans agreed or undertook steps to change top management, and only 3 percent (or two out of sixty-three firms) committed to new investments or changes in the membership of the firms' oversight board of directors.

Although the operational changes were reported in the survey questionnaires to be part of the reorganization plans, it is likely that in many cases they were undertaken simultaneously but were not formally included in the plan. Large Hungarian state firms downsized dramatically in the early 1990s. The largest 150 manufacturing firms, for example, reduced their work forces on average by 47 percent from 1989 to 1993, in response to an average decline in sales of 60 percent (Balcerowicz and others forthcoming).

As in the case of financial plans, the operational restructuring plans were far less ambitious in the cases of unsuccessful reorganization, with fewer than one-half as many firms committing to or undertaking changes as in the group with successful outcomes. Again, this result likely reflects less commitment to *real* restructuring (and in some cases greater prebankruptcy value diversion) in this subset of firms.

In sum, analysis of the reorganization plans of firms that successfully emerged from Hungary's reorganization process indicates that the plans had significant, albeit rather unsophisticated, content. They were primarily focused on short-term debt relief and continued downsizing, and generally did not envision new investment, new management, or innovation. Creditors were clearly not imposing radical changes in business as usual on these firms, and control over firms' assets did not shift to new agents.

Recent literature in corporate finance stresses the importance of changing control rights over firm assets in times of financial distress. However, a number of authors, including Dewatripont and Tirole (1994), have suggested that control rights should not necessarily be shifted when an economy is subject to a systemic shock, because the cause of the bankruptcies may not have been poor management. Rather, workout processes are needed that keep control over productive assets in the hands of those who know how to use them. Such reasoning could arguably apply in the case of Hungary and other transition economies.[5]

INITIAL OUTCOMES OF THE REORGANIZATION PROCESS. What happened to the firms that emerged from the reorganization process with agreed plans? Outcomes to mid-1994 (on average about two years after filing) are shown in table 9. More than 90 percent of the firms on average—89 percent of the large ones and 96 percent of the small ones—were still in operation in mid-1994. The large

5. We are grateful to an anonymous referee for this point.

Table 9. *Outcomes through 1994 of Reorganization Agreements for Firms*
(percentage of firms)

Process category and firm characteristic	Large firms	Small firms
Firms still in operation in mid-1994	89	96
Restructuring		
Made new investments	14	7
Sold major assets	40	11
Had access to new bank credit	17	11
Changed top management	34	26
Significantly reduced employment	71	48
Made major changes in production profile	14	7
Financial performance		
Improved	49	63
Expect to make a profit in 1994	31	63
Anticipate having to file for bankruptcy or liquidation again in 1994 or 1995	31	11
Firms with improved financial performance		
More favorable price structure for outputs and inputs	5	15
Higher sales volume	74	40
Lower interest payments	16	0
Improved repayment rate on receivables	37	35
Improved inventory management	74	55
Reduced material expenses	74	40
Reduced wage bill	37	40

Note: The data are for thirty-six firms in the sample with successful reorganization agreements in 1992–93.

Source: Authors' calculations.

firms had made greater changes than the small ones since emergence from reorganization, which perhaps reflects their worse starting position. Of large firms, 71 percent reported having significantly reduced employment, 40 percent having sold major assets, and 34 percent having changed top management. Only 14 percent, or about one in seven, however, reported having made major changes in production profile, having made new investments, or having had access to new bank credits. About one-half reported improved financial performance, and about one-third expected to make a profit in 1994. However, another third expected to have to file for reorganization or liquidation again.

The major reported reasons for improved performance in firms reporting overall improvement were higher sales, reduced input costs, and improved inventory management. Lower interest payments were relatively unimportant despite the financial reorganization agreements. Perhaps these firms reduced debt liabilities but not necessarily actual debt service, if they were previously unable to service all of their debt. Even if actual debt service did not decline substantially, the debt reduction may nevertheless have led to greater opera-

tional efficiency if it resolved the debt overhang problem. The relative magnitudes for small firms were comparable to those for large firms, but the overall percentage of small firms that reported changes in various restructuring indicators was about one-half that of large firms. Yet, the overall improvement in financial performance was somewhat stronger for small firms than for large firms, probably because small firms experienced less serious financial distress prior to bankruptcy.

In sum, postreorganization performance appears to be primarily a story of belt-tightening combined in many cases with higher sales volume and better financial performance. Innovative restructuring appears to have been rare, as indicated by the low percentage of firms that reported major changes in production profile. Two-thirds of the firms that entered the process expected to survive, and one-third were reportedly already profitable in 1994. Taken together with the institutional strengthening engendered by the process, this is arguably a modest success story.

The Direct Effects of Liquidation

The original design of the bankruptcy law was envisioned as providing two avenues for ailing firms: reorganization and liquidation. However, it is clear both from the results of our study and from numerous discussions with liquidators and other involved parties that the liquidation process does not necessarily result in exit.

Of the fifty cases of liquidation in our sample (including twenty-two originally filed as liquidations and twenty-eight transferred from reorganization, see table 1), only one case (that of a small firm) had been completed by mid-1994, approximately the two-year deadline under the law. About 40 percent of the firms in our sample were still in operation two years after the original filing date (table 10), and the great majority of these had remained under the same management as existed in the firm prefiling. Larger firms (particularly those transferred from bankruptcy) were more likely to remain in operation than smaller firms. Furthermore, the overall percentage of workers expected to maintain jobs with the subsequent users of assets was about one-third for larger firms and slightly less for smaller ones.

In essence, there appear essentially to have been three broad types of firms involved in the liquidation process in 1992 and 1993: shell firms, which had few, if any, assets when liquidation was filed; small firms (mostly private), which were quite easy to liquidate and thus were often closed relatively quickly; and larger firms (mostly state owned) with significant assets, which were rarely closed completely during a liquidation proceeding.

Why did so many firms continue in operation during the liquidation process, despite the fact that liquidation was originally designed as an exit process? Data from the survey and from related interviews support the view that liquidators in large part saw their role as restructurers and privatizers, rather than simply as liquidators. They worked closely with the management of the debtor firm, and

Table 10. *Outcomes of Liquidation for Firms*
(percentage of firms)

Indicator	Transfers from reorganization		Liquidation filings	
	Large firms	Small firms	Large firms	Small firms
Firms operating as a going concern during liquidation	57	23	40	33
Firms remaining under existing management after liquidation filing	44	11	30	29
Claims expected to be recovered by				
Workers	100	60	62	64
Secured creditors	46	41	23	26
Unsecured creditors	17	2	9	6
Workers maintaining jobs with subsequent users of assets	36	11	36	33

Note: The data are for the thirty-three to thirty-nine firms with valid answers of the fifty firms in liquidation in the sample.

Source: Authors' calculations.

they tried to find purchasers of the firms in whole or in part, while preserving as many jobs as possible. One reason why this strategy was so common is the structure of compensation for liquidators: as long as the firm continued in operation, the liquidator was entitled to a fee of 2 percent of gross receipts; if assets were sold, liquidators were entitled to 5 percent of the sales price. Furthermore, the costs of liquidation included any costs incurred to keep debtor firms going during the liquidation process. The costs could include, for example, the fees of consultants hired to assist the liquidator. These costs had top priority, even above secured mortgage liens. Clearly there were financial incentives for liquidators to keep some firms in operation.

Although it was perhaps good news for some Hungarian workers and some parts of the Hungarian economy that the liquidation wave did not force the exit of firms, it was not necessarily good news for creditors or for firms seeking credit. Creditors reported that they had very little influence over the decisions of liquidators. The percentage of claims expected to be recovered by creditors (see table 10) was not low by international standards, although expectations were likely to overstate eventual recoveries. Banks generally claimed in interviews, however, that they expected in reality to recover very little, and only after years of delay while the liquidator negotiated as painless a restructuring and sale as possible for the firm.

Although the number of reorganization cases dropped dramatically after late 1993, reorganizations were indeed still occurring through the liquidation process. The liquidation process became a major route for the restructuring of problematic state-owned firms in Hungary. *What the system lacked then, and still lacks, is an efficient and dependable exit process on which creditors can rely as*

a final stage in debt collection. The weakness of exit, together with the problems of foreclosure on collateral at earlier stages of the debt collection process, almost certainly raises the cost of credit in Hungary.

Privatization and Institution Building

Although bankruptcy may not be an efficient reorganization or exit mechanism for firms in their entirety, it has been an important avenue for privatization and recombination of existing assets in the economy, either as parts of firms as going concerns or merely as individual assets (Stark 1996). The bankruptcy law has probably been one of the main stimulants of privatization in the Hungarian economy since 1992. Not only have the formal processes of reorganization and liquidation involved significant sales of assets, but the mere existence of these processes has created incentives for managers to spin off valuable assets into new entities (often partially or wholly privately owned) while leaving liabilities in problem firms to enter bankruptcy. Furthermore, in the case of state-owned firms, the liquidation process to date appears to be as much a privatization process as an exit one, because liquidators have put enormous efforts into finding private buyers for viable parts of these firms.

In addition, the impact of the bankruptcy process on institutional development in Hungary is, in our view, as important as its immediate impact on bankrupt firms. The bankruptcy process has stimulated the development of a cadre of professional trustees and liquidators with in-depth knowledge of techniques of financial and organizational restructuring. Hungary has been willing to license both foreign and domestic firms as liquidators, and the foreign participation has brought outside knowledge and expertise into the picture. It has also led to an increase in the number and commercial expertise of judges and in the sophistication of the banks' understanding and approach to debt collection. Such learning by doing, even if fraught with problems and mistakes in the early stages, may be the only way of building these important institutions of a market economy.

IV. CONCLUSIONS

Several broad conclusions can be drawn from the data and discussion we presented. First, *the bankruptcy process appears to have had some degree of economic logic in 1992 and 1993.* Better firms were more likely to enter and emerge successfully from the reorganization process, and worse firms were more likely to either fail in the reorganization process or file straight for liquidation. Furthermore, although the reorganization plans and related negotiations between debtors and creditors were not anywhere nearly as sophisticated as those in mature market economies, they did appear to address some core issues—debt restructuring, debt relief, and in some cases operational downsizing. There was scarce evidence of deep restructuring or of management change—a clear indication that the process was less than ideal.

But it was not a totally meaningless exercise with economically irrational or counterproductive results, nor did it result in the immediate forced closure of potentially viable firms. Given that Hungary's bankruptcy experiment was the first of its kind in the transition world, we can perhaps interpret this as a modest success.

Second, the experiment also supports the view that *judicial reorganization need not be slow and costly*. The first wave of reorganizations was handled surprisingly quickly, particularly considering the sheer number of cases, the novelty of the process, and the shortage of trained judges. This relative quickness is largely attributable to the decentralized design of the process. Once a case was approved by the court to proceed, the court had little role. The strict time limits laid out in the law also helped in assuring a relatively speedy resolution of cases.

With regard to speed and cost, it is very possible that the amendments in 1993 took a turn in the wrong direction in requiring the appointment of a trustee (chosen from the list of licensed liquidators) in all reorganization cases. Such a requirement made the process more bureaucratic and expensive. If creditors believe a trustee will help represent their interests, they should be given the option of appointing one (as provided in the 1991 law), but this need not be a requirement. Indeed, if the creditors are not motivated to look after their interests, it is unlikely that a trustee will do it for them effectively.

Third, the major delays in the process in our sample occurred not in reorganization but rather in liquidation. Much of this delay was attributable to slowness in the appointment of liquidators to cases, which led to significant opportunities for asset diversion. However, some of the delay was also attributable to the fact that *liquidation was to a large extent perceived by all parties more as reorganization than as pure liquidation*. This became even more true after late 1993, when the number of reorganization cases began a steep decline—that is, when liquidation appears in effect to have replaced reorganization as the primary restructuring process. Interviews with liquidators and firms confirmed that many if not most liquidators saw themselves as active restructurers, representing first of all the interests of employees or the public rather than the interests of creditors. Virtually all real firms (as opposed to shells or firms with minimal assets, of which there were plenty) stayed alive during the liquidation process as the liquidator looked for ways to privatize their viable parts. Although this situation may have been good for restructuring and privatization, it was not necessarily good for creditors, who felt powerless and unrepresented. It is no wonder that creditors would do almost anything to avoid filing for liquidation. In the end, this lack of a viable creditor-led exit and debt collection mechanism harms firms, because it increases the cost and reduces the flow of credit in the economy.

It was noted earlier that one important reason for which liquidators took their time to settle their cases was the structure of their fees. The Hungarian government should consider a change in the fee structure so that liquidators'

fees consist *only* of a fixed percentage (whether 5 percent or another figure) of proceeds from the final sale of assets. This rather simple change could have a major impact on the process, speeding it up without sacrificing the incentive to save viable going concerns and better aligning the interests of the liquidators with those of the creditors.

Fourth, although the bankruptcy process displayed some economic logic, *one should not assume that it operated as a similar law would in a market economy.* The incentives for creditors to pursue debt collection aggressively are not yet as strong in transition economies, such as Hungary, as in mature market economies. In the case of banks, for example, these incentives have been compromised by successive bank recapitalizations, which encouraged banks to turn to the state for assistance rather than depending primarily on the pursuit of problem debtors. Not only are creditor incentives somewhat weak, but the watchdog institutions that we take for granted in mature market economies—such as accountants, lawyers, judges and other court personnel, credit rating services, bailiffs—are still in their infancy. Thus, creditors find it extremely difficult to gather *the information with which to defend their interests even if they are motivated* to do so. The result is that bankruptcy processes (and what happens immediately before them) appear to be controlled to a far greater extent by debtor management in Hungary and other transition economies than in mature market economies.

What does such managerial control imply for the outcome of the bankruptcy process? In essence, it implies that these managers, and to some extent the debtor firms they manage, will gain more than they would if the process were better monitored and controlled by creditors. *A likely source of gain in Hungary appears to have been asset diversion or other value stripping prior to bankruptcy.* Valuable assets were transferred to separate firms prior to filing (and the records disappeared so the transfers were not later traceable by creditors, trustees, or liquidators), leaving the less valuable assets and the liabilities to enter the bankruptcy process. Interviews we undertook indicated that such asset diversion may have been quite common in 1992 and 1993, for both state-owned and private firms, although the survey was unable to capture this phenomenon on a wide scale (which is not surprising, given the secretive nature of such transfers). Creditors could also have been involved in asset diversion, by colluding with the debtor firm to transfer assets and thus repay that particular creditor prior to bankruptcy at the expense of other creditors. In mature market economies, such transfers in anticipation of bankruptcy are void or voidable by the trustee. They are by law also voidable in Hungary, but liquidators reported tremendous difficulty obtaining necessary evidence, mostly because of underdeveloped watchdog institutions.

It is not easy to control asset diversion, but certain policy steps can help. *The major need is to strengthen the incentives of creditors to monitor the process closely, and to improve their capacity to do so.* Creditors can be assisted in the short to medium term by

- Changing collateral and bankruptcy laws to put secured creditors clearly *first* in priority of recovery (even above costs of the proceedings)[6]
- Streamlining courts' and bailiffs' procedures to lower the costs of foreclosure on collateral
- Changing the compensation of liquidators (as described above) to align their incentives clearly with those of the creditors
- Changing bankruptcy regulations to require the appointment of a liquidator immediately after a case is filed, so as to eliminate the long period between filing and approval during which incentives for value diversion are at their peak
- Strengthening banking reforms and privatization to reduce bank ties to the state (and thus the expectation of state subsidies)
- Strengthening macroeconomic discipline and enterprise privatization to reinforce the incentives of trade creditors to actively pursue collection of their debts
- Avoiding alternative government-led workout programs (such as debtor consolidation) that may be perceived as backdoor avenues for state subsidization of debtors or creditors.

Finally, and more generally, it is important to recognize that developing the institutions of a market economy, particularly the watchdog institutions referred to earlier, is a massive task and necessarily takes time. It will be greatly facilitated, however, if tight macroeconomic discipline leads to hard budget constraints, and thus firms and banks *demand* these institutions because they no longer view the state as their automatic safety net in times of financial distress.

Was the Hungarian experience a success? Was the automatic trigger that set it off a good idea? The answer depends profoundly on expectations. On the one hand, the Hungarian bankruptcy process in 1992–93 was not nearly as efficient or effective as bankruptcy experience in mature market economies. This was inevitable, given the distortions in incentives and the weakness of institutions in the transition setting. On the other hand, it was a start in the right direction. The controversial automatic-trigger mechanism put in motion a process that helped change perceptions and stimulated needed institution building. It strengthened financial discipline in firms and furthered asset privatization and the building of a new profession of trustees and restructuring experts. Such a trigger is clearly not needed in mature market economies with diligent creditors, and it was arguably too draconian even in Hungary. Even if a trigger is adopted, a period of ninety days is almost certainly too short, given that it barely exceeds average payment periods in market economies. But some artificial trigger may nevertheless be useful in the very early stages of transition to help make bankruptcy a working reality and a viable option for creditors and debtors. The Hungarian bankruptcy experience should not be discarded but rather should be

6. A step in the wrong direction was Law No. 53, adopted in September 1994, that placed all government liens ahead of secured credit in priority of recoveries in cases of asset foreclosure.

strengthened through strong and broad complementary reforms toward a market economy.

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Why and When Do Governments Initiate Public Enterprise Reform?

Jose Edgardo Campos and Hadi Salehi Esfahani

Initiating public enterprise reform is a complex decision influenced by economic factors as well as the ideological biases and personalities of political leaders. Nevertheless, the use of a contracting framework yields important generalizations about what drives the decision. This article argues that the decision depends fundamentally on the potential efficiency gains from the reform and its associated transactions costs. Costs arise because of asymmetries in information and opportunism, problems that usually plague contract negotiations. The article identifies observable variables that may affect either the potential gains or the transactions costs, uses them to construct a simple probit decision-making model, and tests the model using data from fifteen developing countries over a twenty-year period.

In the last ten years considerable attention has been cast on public enterprises, much of it centering on their poor performance and the burden they impose on national treasuries. Yet in many countries, reform of such enterprises has proceeded at a slow and uneven pace. Many governments have been reluctant to alter incentives within the public enterprise sector that would improve efficiency, and are even more reluctant to privatize. Even under intense pressure from external agencies, some governments have muted necessary large-scale reforms. Clearly, factors other than economic efficiency influence the possibility, nature, pace, and extent of public enterprise reform. The objective of this article is to identify some of those factors.

We adopt the view that economic policies represent a set of contracts between the government and various socioeconomic groups that addresses problems of market failure and demands for redistribution. There is no shortage of frameworks for analyzing the determinants of economic policy, but most rely on concepts that are difficult to operationalize and test. For example, models of economic policy based on the notion of the degree of state autonomy (for example, Evans 1992) are not falsifiable. Also, models of

policy reform focused on the role of "insulated change teams" (for example, Waterbury 1993) are incomplete. Since such teams are themselves a creation of the government, they cannot serve as explanatory variables. The existence of the team is an endogenous variable that must be explained as part of the overall policy determination. Finally, there is a whole gamut of interest-group or class-based theories. Our framework is in part interest-group based, but it differs from the others in that it treats the government (or the state) as an independent actor, not simply as a passive agent of interest-group demands. Our approach is most closely related to North's (1981) "predatory state," although in our approach the state might be termed pragmatic rather than predatory. The idea of economic policy as a contract can be dated from at least Goldberg's (1976) proposal to analyze regulation as an administered contract.

According to our framework, policy reform can be interpreted as a renegotiation of contracts that entail direct government involvement in production toward more efficient, market-oriented ones. But to consent to a reform package, interest groups that currently support or could support the ruling coalition must know what they will gain from the reform, how the gains will be distributed, and whether the distribution of rewards will indeed be honored by the government. Thus the reform decision is hampered by the usual contracting problems— that is, problems of information and opportunism.

Imperfect and asymmetric information between interest groups and the government can lead to prolonged bargaining, to resource expenditure on signaling and screening, and to fewer options for recontracting. Opportunism also reduces recontracting options and calls for costly arrangements to convince interest groups that they will receive the rewards promised to them. Opportunism is a potentially serious problem in government-interest group contracts because many terms of such contracts are implicit, given the government's role as the enforcer of its own responsibilities. Lack of well-defined property rights also makes it difficult to determine when the government is acting in an expropriatory manner. These problems can be partially mitigated by institutions and rules that constrain the government, but such a solution is often incomplete. In particular, the need to ensure procedural fairness impedes flexibility and efficiency (Owen and Braeutigam 1978). Furthermore, because property rights are at least partly implicit, it is difficult for the government to obtain commitment from, or compensate, agents affected by policy changes.

Both opportunism and information problems involve transactions costs, whose magnitude depends (positively) on the volume of redistribution entailed by the reform; that is, a reform entails both benefits and costs. Benefits stem from the efficiency gains that would accrue from the reform of the public enterprise sector. Costs arise from the risks that the reform poses to the government and its constituency and from the need to establish mechanisms to reduce such risks.

A government's decision to reform public enterprises depends on whether the potential efficiency gains exceed the associated costs.[1] The government can use the gains to compensate losers and to reward new supporters; however, because it has to shoulder some costs to produce those gains, it would do so only if net gains accrue. This approach is a close cousin of Rodrik's (1994), which uses the concept of "efficiency gains-redistribution cost ratio" as the main determinant of trade reform. We take the analysis further: we derive the relationship between the decision to reform the public enterprise sector and a number of structural and institutional variables that influence the related costs and benefits.

On the basis of this framework, we derive several operational hypotheses relating the reform decision to the broad characteristics of the economy and the public sector that can have a significant impact on the costs and benefits of public enterprise reform. We compile a data set to carry out preliminary tests of the hypotheses and to show how the methodology can be used for predicting whether or not countries attempt reform. In particular, we present evidence relating reform attempts to macroeconomic downturns, the extent of public ownership in the economy, the sectoral structure of the economy (specifically, the relative size of the nonagricultural sector), per capita income, and the degree of openness to international trade. The relationship between some of these variables and macroeconomic and trade reforms has been discussed in the literature, but empirical evidence is scarce. (See, however, Rodrik 1994, Alesina 1994, Drazen and Grilli 1993, and Edwards 1993.) Similar investigations in the case of public enterprise reform are, to the best of our knowledge, rare.

We focus on the attempt to reform, not on the success or failure of such attempts. We deal with the latter issue in Campos and Esfahani (1995). Our concept of reform attempt includes actions by the government, such as privatization, commercialization, and so on, to enhance efficiency through changes in the incentives facing public enterprise managers. To qualify as a reform attempt, these changes must affect more than just a few small public enterprises. Section I of this article describes our analytical framework; section II analyzes the influence that economic downturns and a country's economic structure and trade orientation have on public enterprise reform; and section III concludes. Our choice of variables is explained in the appendix.

I. The Analytical Framework

That political leaders strive to remain in power is a basic fact of politics. In industrial democracies as well as in strong-arm dictatorships, politicians constantly seek to keep their power. In the United States in particular, incumbents use their position to increase their chances of being reelected (Erikson 1971; Mayhew 1975), and, as a consequence, reelection rates have increased tremen-

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1. Galal and others (1994) extensively document the gains from selling public enterprises. Although their work covers only privatization, it suggests that, in many circumstances, public enterprise reform can yield substantial gains.

dously over time (Fiorina 1989). In many developing economies, political leaders have all employed various means to stay in power; see, for example, the Kuomintang in Taiwan (China) (Amsden 1979; Wade 1990), the military regimes in the Republic of Korea (Amsden 1989; Haggard 1990), the post-independence governments in Zambia and Ghana (Bates 1981; Bates and Krueger 1993), and the populist and conservative parties in Argentina (O'Donnell 1978). It is therefore reasonable to assume that the dominant political objective of any regime is to remain in power and that a regime formulates policies and strategies around this objective.

Retaining power requires establishing sufficient political support from the polity. Without such support governments fall, coalitions collapse, dictators are deposed, parties are defeated, and presidents are unseated. Political support is obtained in part through quid pro quo arrangements—income transfers exchanged for support, such as votes or campaign funds. Governments "sign" social contracts with various socioeconomic groups. For example, in industrial countries, regulation is often used to direct transfers to politically influential groups. Farmers in Canada, Japan, the United States, and Western European countries have long benefited from regulations that raise their incomes above what they would be under free market conditions (Gardner 1981; Rausser 1982; Michelmann, Stabler, and Storey 1990). In developing countries, protection of domestic oligopolistic industries from import competition has been extensive (Little, Scitovsky, and Scott 1970). More generally, empirical work has shown that government intervention has often been used for redistribution (Stigler 1971; Anderson and Tollison 1984; Rowley, Tollison, and Tullock 1988; Michelmann, Stabler, and Storey 1990; Krueger 1974; Bates 1981; Bardhan 1984; Ake and Mohammed 1986). And theoretical work has shown this to be a logical outcome of a "tenure-maximizing" regime—one that stays in power for as long as possible (Brock and Magee 1978; Becker 1983; Findlay and Wellisz 1984). Government interventions cannot be divorced from issues of redistribution, because it is partly through redistribution that a regime sustains itself.

Redistribution in this context does not necessarily mean a transfer of wealth from rich to poor—in the real world of politics it often means transfers from the less influential to the more influential. The more influential groups are typically better organized and thus more capable of providing support for, or withdrawing support from, the incumbent regime (Olson 1965). Such groups might be firms in large, highly concentrated industries; labor unions; urban groups; the military; ethnic groups; landlords; or even individuals capable of influencing less organized groups. In addition, the threat of participation in spontaneous riots and revolutions could help channel benefits to unorganized groups as well. The large consumption subsidies in the form of cheap staples maintained in many countries may reflect such concerns. Whatever the case, regimes must pay close attention to the demands of at least a subset of interest groups, and more often than not, these demands include some form of transfer.

Several implications for public enterprise reform follow from this framework. Redistribution can be accomplished directly or indirectly. Regulation is an indirect instrument for redistribution; the operation and control of public enterprises is a more direct instrument. Public enterprises are a convenient vehicle through which regime leaders can redistribute wealth. State ownership and control over employment, wages, input purchases, and so on give the regime easier access to resources with which to reward supporters and punish detractors. Thus, although these enterprises may genuinely address some market failure or social objective, they are temptations for a regime, which can use them to build and maintain political support. They are particularly tempting to regimes in developing countries, where political institutions are much less developed—mechanisms for establishing and enhancing accountability, transparency, and competition take generations to mature. We would thus expect these enterprises to be used to promote politically motivated redistributive arrangements, as Campos and Esfahani (1994) prove with evidence from a wide range of countries indicating the extensive use of public enterprises for politically motivated redistribution.

Given the importance of public enterprises in securing political support, regimes would likely resist reform. But when rent redistribution and centralized control significantly distort production incentives and cause large efficiency losses, political leaders may search for ways of exploiting the gains from increased market orientation to buy further support from their existing or potential constituency. The larger the expected efficiency gains are, relative to the political and economic costs involved in providing alternative means of rent allocation or changing the existing allocation, the more attractive the reform option is.

Expected efficiency gains depend on two factors: the extent of inefficiency and the extent of the reform's credibility (that is, the likelihood that the reform measures will be sustained in the future). The costs of redistribution, on the other hand, depend on the volume of redistribution and the information imperfections regarding the distribution of gains and losses across interest groups. Information asymmetry, in particular, increases the costs of policy renegotiations, because it can give rise to a war of attrition in which each interest group delays reform by refusing to concede, claiming that its gains from reform are small—and thus that the reform costs must be shifted toward other groups (Alesina and Drazen 1991).

The costs of public enterprise reform are likely to be commensurate with the amount of rent that is redistributed through public enterprises. The reason is that at the time such rents come into existence, the recipients either attempt to erect political and legal means to protect those rents or condition future political support on implicit or explicit guarantees of continued rent flow. This point has long been made in the literature on rent seeking (see, for example, Krueger 1974) and is to some extent inherent in any arrangement for creating incentives (whether for production or for political support). Incentives do not take effect without some institutional mechanism ensuring that the arrangement is difficult

to change unilaterally and, therefore, promises of future rewards are likely to be honored. The costs that such rent and incentive-protection mechanisms impose on policy change can be exacerbated by informational problems. These provide an additional explanation for the persistence of inefficient policies and can also help explain why reform of public enterprise policies often takes the form of abrupt change rather than gradual adjustment to new information and unfolding events. Renegotiation costs are likely to be fixed, and every time the government modifies its policies, the agenda for redistributing rents opens up. Then the regime has to deal with rent-protection mechanisms.

Innumerable variables may influence the size of potential efficiency gains, rents, reform credibility, and informational imperfections. Shifts in these underlying variables alter the economic and political calculus of policy change and may trigger reform. Later we focus on a number of important variables that can be measured more easily and can be used to predict a given country's readiness for reform. Naturally, this procedure leaves out many other important but less quantifiable variables. In particular, many of the variables that influence a reform program's credibility are difficult to document and analyze. Other sets of relevant but hard-to-measure variables are the structure of rent distribution through public enterprises, the nature of beneficiary and loser groups, and the structure of the country's politics. For example, the costs of reforming a public enterprise are likely to differ if the public enterprise is used for passing on rents to consumers rather than to input suppliers. Similarly, the political influence of the recipient groups with respect to others and their ability to claim part of the gains from reform are also relevant factors. Given the limited scope of available data, we have little choice but to rely heavily on key aggregate variables that can be more easily documented.

In the case of credibility we assume that past actions of the government and the consequences of those actions can serve as the main variables. Specifically, we use the degree of outward orientation of the economy as a measure of commitment to liberal economic policies. However, institutional structures that make policy change difficult also lend credibility to reform policies, unless the policies are inherently unsustainable. We do not incorporate institutional structures in our present analysis, mainly because we do not have a comparable measure of the cost of such policy change across countries. But we do not see this as a major bias in our results, because the same barriers also add to the costs of adopting the reform, although institutional barriers to policy change increase the probability that the gains from a reform will be realized. In this sense the net impact of institutional structure on reform attempts may be small, although, as we show in Campos and Esfahani (1995), the impact on the success of reforms, once the reforms have been adopted, is significant.

In the following pages we focus on a limited number of variables and argue why these variables are important for public enterprise reform and what theoretical influences they might have on the reform decision. Since our arguments are mostly heuristic, the readers may disagree with some of the theoretical links

we establish. When the readers do disagree, they may simply view our empirical work as an attempt to identify a number of important predictors of public enterprise reform (see the appendix).

Because many variables are involved in the economic and political calculus of reform, no single variable can be pinpointed as the sole cause. Each variable influences only the probability of the initiation of reform, given other variables. For example, although we identify economic downturns as a catalyst for reform, they are neither necessary nor sufficient for reform. If other underlying variables raise the expected efficiency gains relative to the costs of redistribution sufficiently, a reform could materialize, absent an economic downturn. Likewise, a downturn may not necessarily induce a reform attempt if other conditions are not met.

Economic Downturns

The literature on macroeconomic and trade reform recognizes the relationship between economic crises and policy change.[2] (For recent discussions of the relationship between economic crises and macroeconomic and trade reform, see Rodrik 1994, Alesina 1994, and Drazen and Grilli 1993.) Our framework suggests that this relationship may also apply to public enterprise reform. To be sure, there may be a trivial relationship between economic downturn and privatization if economic crises cause extensive failure in the private sector and the government is forced to adopt and rehabilitate them. In such cases, privatization may simply reflect returning the economy to its long-term growth path. Such episodes are relatively rare, however. The more common case of reform, which we discuss in more detail in the next section, involves changing the incentives for firms that have long operated as public enterprises. We also argue that macroeconomic downturns are the forms of economic crisis most likely to lead to public enterprise reform.

In our analysis we ignore the possibility that sectoral- or industry-level crises may also trigger reform for three reasons. First, in developing countries, public enterprises are present in many sectors, and substantial reforms in the public enterprise system often require relatively widespread adverse shocks. (In our definition of "reform attempt" in section II, we exclude cases in which policy changes have been minor or have affected an insignificant portion of the public enterprise system.) Second, when crises are limited to a sector or an industry, the government can use resources from public enterprises in other parts of the economy to mitigate the consequences for groups that support the government. This possibility curtails the impetus for reform, compared with situations in which the shrinkage of resources is more widespread. Third, significant sectoral-

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2. Political crises are also sometimes mentioned as factors behind reform attempts. Our contracting framework suggests that, if anything, political crises should delay reform because they shorten the regime's horizon and reduce the survival probability of any reform program. But testing these hypotheses is not easy, because it is difficult to identify episodes of political downturn. Our experiments with a few indicators were inconclusive.

and industry-level crises are likely to be reflected in macroeconomic performance.

Why should we expect a strong adverse economic shock to induce a regime to reform public enterprises? Given a regime's desire to maintain power, a regime should not wait to act until things deteriorate badly. One explanation lies in the impact that shocks have on both the potential gains from costs of reforms and redistribution of these costs. The explanation that follows is along the lines argued by Rodrik (1994). In the context of trade reform he argues that, for every dollar of efficiency gain, some amount of income is effectively transferred from those that were beneficiaries under the status quo to other groups. During a downturn, this amount is much smaller. This, suggests Rodrik, explains why trade reform is politically so difficult in normal times and why times of downturn provide an opportune moment for undertaking structural reforms. Similarly, Drazen and Grilli (1993) argue that, in the context of Alesina and Drazen's (1991) war-of-attrition model, reform is accepted sooner if an economic downturn increases the costs of the status quo relative to the postreform situation. However, they go further and demonstrate theoretically that introducing distortionary policies to induce a downturn may be welfare enhancing for economies caught in a low-level political equilibrium. Bradburd (1993) and Waterbury (1993) make somewhat different arguments. Bradburd's argument is based on asset specificity. He argues that groups will continue to block efforts to change the existing arrangements only if the assets whose values depend heavily on the continuance of these arrangements fall below lobbying costs. Waterbury maintains that a free-rider problem keeps groups from opposing reforms during a downturn. Maintaining the status quo is a public good for those groups who benefit from it. During a downturn, the benefits to each group shrink, and thus no single group has the incentive to absorb the cost of lobbying. Each group would rather concentrate on striking individual deals with the regime in order to cut its losses. The result is that none of the beneficiary groups do anything to preclude reforms.

As we have argued above, the costs of renegotiating the implicit or explicit contracts that are part of the existing public enterprise policy impede attempts to remove inefficiencies. But movements in the underlying determinants of costs and benefits can tip the balance and trigger reform. Adverse shocks to domestic production can play such a role, because they tend to reduce the rents available through public enterprises, and thus diminish the amount of redistribution required to achieve market-oriented reform. For example, when public enterprise production falls because of a shortage of imports, the government will have fewer resources available to transfer to public enterprise workers or customers. Thus lower amounts of rent will be taken away from the beneficiaries when the reform takes effect: the current beneficiaries will lose less.

The potential gains from reform, however, are unlikely to decline and may increase when the economy experiences a long-term adverse shock. The reason is that, in the absence of market orientation, public enterprises respond slug-

gishly to shocks. As a result, sectors dominated by public enterprises will be much slower to rebound, making it more difficult for resources to flow toward their optimal uses and for growth to resume. There is an issue regarding the potential gain from the privatization of a specific firm: a negative demand shock may in fact reduce the gain. But for a large-scale reform in developing countries, this effect is unlikely to arise. In contrast to the situation in industrial economies, where demand shocks are generally caused by a fall in consumption or investment demand, in developing countries such shocks are more often caused by the government. The government is typically predisposed to overspending, so that weak aggregate demand (without prior runaway inflation) is rarely a problem: generally the government constricts demand in order to control inflation. Part of this intervention includes reducing the deficits of public enterprises, which in turn induces a fall in the rents that are distributed through public enterprises. This drop reduces the opportunity cost of the beneficiaries of those rents and thus the potential opposition to large-scale public enterprise reforms. Instituting reforms then creates the potential for efficiency gains, since privatized public enterprises will have more flexibility (than traditional, bureaucratically controlled public enterprises) for exploiting new possibilities once demand returns to normal.

Regimes may also delay reform until an economic downturn occurs because of underlying uncertainties about the distribution of gains and losses. Before economic conditions deteriorate, interest groups are likely to be uncertain about who will lose if no action is taken to prevent economic decline. They are also likely to be uncertain about which policy would prevail once attempts to dismantle the status quo begin and about what the outcome of a given reform program would be. Such uncertainties can discourage political actors from attempting to initiate reform, because expected costs may outweigh gains for decisive groups (Howitt and Wintrobe 1995; Fernandez and Rodrik 1991). But once a downturn occurs, part of this uncertainty will be resolved, because certain groups will find themselves on the losing side. Although the uncertainty about the outcome of various reform options may remain, the implicit social contracts become easier to renegotiate. In short, an economic downturn raises the ratio of potential gains to redistribution costs and thus encourages reform. We posit that *economic downturns create conditions that make regimes more likely to introduce public enterprise reforms.*

A related explanation is that even if the government does foresee the crisis, it may not have the political support to launch a reform, since the general population may not recognize the onslaught of a crisis. Only when the crisis materializes does the general population come to recognize it, and only then will the population be willing to take sides.[3]

But a downturn is not always sufficient to jerk a political regime into action. Many countries have experienced major downturns, and their governments did

3. We are grateful to one of the referees for pointing this out.

not attempt to introduce public enterprise reforms; nor is it necessary—countries have embarked on reforms even when no shock had occurred. Other factors influence the likelihood that a regime will undertake a reform.

The Structure of the Economy

Potential net benefits of public enterprise reform will likely depend on the activities undertaken in the economy and on how they are divided between the public and private sectors. Because countries with a variety of structures undertake reform, the relationship cannot be a simple one; it needs to be dissected so that it can be specified and measured. In particular, as we argue later, the share of the public sector in the economy has two opposite effects on the probability of reform: a positive effect that arises from the inefficiencies of public enterprises and a negative effect that depends on the complexity of the economy, as reflected by the range of production activities and the linkages among them.

The degree of inefficiency caused by the incentives imposed on the public sector is difficult to measure, though we do know that inefficiencies depend on the type of production. Some activities allow the government to redistribute a great deal of rent at low inefficiency cost, while redistribution through other channels may entail significant production disincentives. For example, in the context of countries that lack the capacity to regulate (owing perhaps to institutional weaknesses), public enterprises may not perform much worse than private enterprises in sectors in which sunk costs are large and the quality of the product is relatively easy to assess. In these countries, however, public enterprises can be highly inefficient in the provision of products that are sensitive to quality (for example, fashion clothing or fresh vegetables and other perishable goods). In these activities, market failure is less likely to occur and, even if it does, it is likely to be of much smaller magnitude. Certainly, government ownership cannot improve performance in markets in which producers must be responsive to the demand for detailed characteristics. As a result, effecting the same redistribution through public ownership in these types of activities is much more costly than in activities in which quality is easily determined. Indeed, in developing countries public ownership has been and remains common in public utilities and heavy industry, but is quite uncommon in fashion clothing and fresh vegetable production. Public ownership of some lines of retail trade was given up even in orthodox, centrally planned economies.

The implicit ranking of economic activities in terms of their efficiency loss per unit of redistribution under public ownership implies that, as the range of activities covered by public enterprises increases, the marginal efficiency gain from reform should increase relative to the costs of redistribution necessary to achieve those efficiency gains (for evidence, see World Bank 1994a). Thus, all things being equal, the net benefits of reform should increase with the relative size of the public sector in the economy.

On the negative side, a larger public sector implies greater renegotiation costs because more information is needed to design and implement the reform, but

less information is available because of curtailed competition. Informational imperfections tend to be smaller when most economic activity is carried out in the private sector, because information about the performance of individual public enterprises and the size and distribution of gains from reform are more readily available when public enterprises interact with private firms as suppliers or competitors. For example, competition from private firms can reveal which manufacturing public enterprises are the worst performers. Or, demands of private firms can expose which public enterprises are the worst providers. This information, in turn, indicates which public enterprises are more likely to be targeted for reform. Such factors help all those affected by reform to better understand what the outcome of reform might be, which groups will gain, and which groups might have to bear most of the burden. Hence interest groups would have less incentive to engage in what Alesina and Drazen (1991) call a "war of attrition." Reformers would also be in a better position to devise more effective incentive and redistribution schemes and thus attract wider support for policy change. In contrast, the wider the range of activities dominated by public enterprises, the greater will be the informational burden of a reform program, and the more costly it will be to undertake a reform.

We can empirically distinguish the two effects, because the negative effect depends on the complexity of the economy, but the positive effect does not. Complexity reflects the underlying informational characteristics of an economy: the more interlinkages there are between different sectors in the economy, the more difficult it is to extract information. As the degree of complexity (set of informational attributes) rises, an increase in the size of the public enterprise sector imposes a higher cost of retrieving the information needed to design a reform program. Therefore, juxtaposing the size of the public sector with a measure of complexity should isolate this effect from other effects of public sector size on the net gains from public enterprise reform.

The complexity of the economy itself has an independent effect. When the activities in the economy are highly interlinked, inefficiency in one part can strongly propagate to other parts. In contrast, when large parts of the economy use few inputs from the rest of the economy, inefficiency in the rest of the economy has a limited impact on the economy as a whole. As a result, the efficiency gain from (and the demand for) reform in a given part of the economy increases as the other parts of the economy become less self-contained. (For a discussion of the concept of self-containment and its application to the role of institutions in determining a country's comparative advantage in international trade, see Clague 1991.)

A variable that is easy to measure and captures the above notion of complexity is the relative size of the nonagricultural sector of the economy. This variable reflects the decline of traditional activities—especially those in agriculture—which are more self-contained, and the rise of specialized activities—especially those in industry and services—which depend on inputs from the rest of the economy. Using this measure of complexity, we can summarize the results of the above arguments as follows: *All things being equal, the probability of public*

enterprise reform is negatively related to the size of the interaction between the public sector and the nonagricultural sector of the economy, but each of these two variables has a positive residual effect on that probability.

The structural characteristics of the economy may also influence the probability of reform through their impact on credibility. To the extent that these variables increase the potential gains from market orientation, they make reversals more costly and increase the probability of adherence to the new policies. In addition, the government's success in developing nonagricultural sectors under private ownership can indicate the regime's commitment to market-oriented policies and lend credibility to its public enterprise reform program. But all of these effects tend to reinforce the relationships delineated above and are difficult to distinguish from them.

Trade Orientation

Outward orientation of a government's economic policy and a government's involvement in international free trade agreements are important indicators of a regime's commitment to market-oriented policies. Thus a public enterprise reform proposed by such a government is more likely to be perceived as a credible extension of previous actions. But in addition, outward orientation influences the efficiency gain-redistribution cost ratio of public enterprise reform and thus at the margin may induce regimes to undertake public enterprise reform. To see this, although many producers and consumers may receive rents from public enterprises, their inefficiencies ultimately increase the cost of production for the economy as a whole. In inward-oriented economies, final demand is relatively inelastic, and higher costs can be largely passed on to consumers. As a result, the benefits of public enterprise reform are diffuse and difficult to assess. In contrast, in outward-oriented economies a large proportion of producers face relatively elastic demands, and domestic inefficiencies affect their level of competitiveness in world markets. These producers can directly gain from increased public enterprise efficiency through cheaper domestic inputs and, to the extent that this effect is mitigated by real exchange-rate appreciation, they can indirectly benefit from cheaper imported capital and intermediate inputs. Therefore, in outward-oriented economies, enterprise reforms produce more visible gains. For this reason we expect that, *given other factors, the probability of public enterprise reform increases with the increased outward orientation of the economy.* This hypothesis also implies that a successful trade reform can induce a public enterprise reform by making the potential gains visible and creating a clear group of beneficiaries.

II. THE INFLUENCE OF ECONOMIC DOWNTURNS, ECONOMIC STRUCTURE, AND TRADE ORIENTATION

As we show in this section, most attempts at public enterprise reform follow an economic downturn, but the likelihood that a reform is undertaken after a

given downturn depends on a country's economic structure and trade orientation. We begin by specifying our indicators for a reform attempt and economic downturn and showing that they are correlated. We then develop a probit model of the reform decision. The model tests whether each of the variables specified earlier has the predicted influence on the probability that a regime will attempt a reform. We end the section with the presentation and discussion of the statistical results.

Our data are based on the experience of a diversified group of fifteen developing countries: Argentina, Chile, Egypt, Ghana, India, Indonesia, the Republic of Korea, Malaysia, Mexico, Nigeria, Pakistan, the Philippines, Senegal, Turkey, and Venezuela. We restrict our analysis to the period from 1972 to 1993 in order to control for the effect of the international environment. The emphasis on private sector-led development in developing countries grew stronger in the 1970s, and, in particular, international lending institutions began to emphasize such policies later that decade. To ensure greater homogeneity in this respect and test the sensitivity of our findings to the selected sample, we also experimented with a smaller sample based on the period from 1978 to 1993. This switch did not significantly change the results.

Downturns and Reform Attempts

By "reform attempt" we mean a proclamation of new policies and guidelines to enhance market incentives of public enterprises, followed by an initiation of some of the proposed policy changes (for example, changes in prices, regulation, layoffs, divestiture, and opening of public enterprise markets). Therefore, changes such as the sale of minority shares in a few public enterprises to raise revenue, or reorganizations of the public sector that shift the responsibility of public enterprises from one government organization to another without giving the enterprises stronger incentives to improve efficiency, do not qualify as reform episodes. Further, it is not enough for policy changes to be announced or to be embodied in new laws and regulations. The proclamation must be followed immediately by the implementation of one or more of the proposed changes.

Of course, there is an element of judgment in labeling some policy changes, especially those in which the scope of change is limited, formal measures are weakened by informal countermeasures, or implementation is marginal and gradual. But as noted later, our results do not appear to be sensitive to possible judgment errors. In general, public enterprise reforms are embodied in the larger context of macroeconomic reforms and are often preceded by such reforms. To assess the sensitivity of our assessment and dating of reform attempts, we also made an alternative count of reform attempts in which we identified a policy change as a reform regardless of whether it was a macroeconomic, trade, or public enterprise reform (or any combination). This indicator is expected to capture public enterprise reforms that start with a macroeconomic or trade reform, which may or may not materialize (see appendix figure A-1 and table 1). In contrast with the public enterprise indicator, which may undercount public

Table 1. *Public Enterprise Macroeconomic Reform Variables and Conditions in Sample Countries*

Country	Years	Public enterprise macroeconomic reform (y_i)	Magnitude of downturn (MD)	Ratio of public to total investment (RPI)[a]	Share of nonagriculture in GDP (SNA)[a]	Interaction term (RPIxSNA)	Trade orientation (TO)[b]	GDP per capita (thousands of 1987 U.S. dollars) (GDPPC)
Downturn episodes								
Argentina	1975–76	0	–4.58	0.3762	0.9195	0.3459	0	3.648
	1978	0	–5.33	0.3958	0.9181	0.3634	0	3.747
	1981–82	0	–12.09	0.3914	0.9184	0.3595	1	3.782
	1985	0	–7.97	0.2460	0.9129	0.2246	1	3.604
	1988–90	1	–11.65	0.2698	0.9132	0.2464	2	3.455
Chile	1972–73	1	–9.11	0.4865	0.9218	0.4485	1	1.447
	1975	1	–13.18	0.6214	0.9259	0.5754	2	1.420
	1982–83	1	–17.51	0.3226	0.9183	0.2962	2	1.477
Egypt	1992	1	–1.77	0.6030	0.7987	0.4816	1	0.739
Ghana	1972	0	–5.94	0.4576	0.4611	0.2110	0	0.523
	1975–76	0	–21.04	0.5645	0.4490	0.2535	0	0.514
	1979–83	1	–28.01	0.7742	0.4795	0.3712	0	0.453
India	1971–72	0	–3.61	0.3820	0.5561	0.2124	0	0.245
	1974	0	–1.09	0.4180	0.5731	0.2396	0	0.241
	1976	0	–0.61	0.4208	0.5804	0.2442	1	0.241
	1979	0	–7.60	0.4338	0.5946	0.2579	2	0.255
	1991	1	–0.70	0.4560	0.6801	0.3101	2	0.342
Indonesia	1982	0	–2.24	0.4350	0.7309	0.3179	2	0.345
Korea, Rep. of	1980	0	–4.87	0.2186	0.7856	0.1717	3	1.660
Malaysia	1975	0	–1.57	0.3146	0.7061	0.2221	3	1.116
	1985–86	1	–5.31	0.4606	0.7818	0.3601	3	1.812
Mexico	1982–83	1	–9.34	0.4240	0.9110	0.3863	3	1.833
	1986	1	–5.79	0.3984	0.9155	0.3647	3	1.948
	1988	1	–0.47	0.3456	0.9133	0.3156	3	1.860
Nigeria	1972	0	–1.81	0.3330	0.4996	0.1664	0	0.376
	1975	0	–6.13	0.4680	0.5346	0.2502	0	0.394

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	1978	0	−8.75	0.6168	0.5961	0.3677	0	0.425
	1981–84	0	−33.70	0.6726	0.6510	0.4379	0	0.427
	1986–87	1	−4.51	0.7320	0.6779	0.4962	0	0.337
Pakistan	1971–72	0	−5.20	0.4950	0.6301	0.3119	2	0.223
	1993	1	−0.10	0.4870	0.7446	0.3626	3	0.354
Philippines	1983–85	1	−20.29	0.3048	0.7675	0.2339	2	0.671
	1991–92	1	−5.27	0.1792	0.7677	0.1376	2	0.600
Senegal	1971	0	−1.51	0.5524	0.7169	0.3960	0	0.723
	1973	0	−8.25	0.4554	0.7369	0.3356	0	0.723
	1977–78	0	−13.16	0.4943	0.7264	0.3591	0	0.710
	1980–81	0	−9.38	0.5087	0.7343	0.3735	0	0.708
	1983–84	1	−7.79	0.3708	0.7720	0.2863	1	0.673
	1989	0	−3.47	0.3284	0.7859	0.2581	2	0.674
	1991	0	−1.77	0.3222	0.7840	0.2526	1	0.679
Turkey	1979–80	1	−6.09	0.4622	0.7941	0.3670	1	1.040
	1989	0	−0.54	0.5410	0.8135	0.4401	2	1.226
	1991	1	−0.09	0.4938	0.8221	0.4060	2	1.306
Venezuela	1971–72	0	−4.25	0.2390	0.9500	0.2271	0	3.297
	1974–75	0	−2.46	0.3236	0.9509	0.3077	0	3.240
	1978–85	0	−29.18	0.3660	0.9516	0.3483	1	3.282
	1989	1	−11.34	0.4164	0.9404	0.3916	1	2.648

Reform episodes without downturn

Indonesia	1986	1	0	0.4648	0.7470	0.3472	3	0.397
Korea, Rep. of	1984	1	0	0.2436	0.8391	0.2044	3	1.996
Malaysia	1991	1	0	0.3882	0.7937	0.3081	3	2.059
Pakistan	1977	1	0	0.5970	0.6615	0.3949	2	0.220
	1990	1	0	0.5274	0.7374	0.3889	3	0.327

a. Values represent the five-year average.

b. Values follow Dollar's (1992) index, which assigns a ranking of 0 through 3 to each observation, with 0 indicating the most inward-oriented set of policies and 3 the most outward-oriented set.

Source: Values for the reform variable (y_t) are based on the authors' evaluations from a variety of sources, including country economic reports of the World Bank, Sundaran (1993), Bates and Krueger (1993), Bruton (1992), Gyimah-Boadi (1993), Means (1991), Haggard and Webb (1994), Waterbury (1993), and Williamson (1994). Values for the other variables come from the World Bank data base.

enterprise reforms and responses, the public enterprise-macroeconomic indicator tends to overcount them. The results we report in the text are not very sensitive to the measure employed.

We define "economic downturns" as declines in real gross domestic product (GDP) per capita, and we refer to the consecutive years in which per capita GDP growth is negative as a "downturn episode." This is of course one of many countless concrete definitions we can give to economic downturn. For example, a certain level of decline in the growth rate might be considered a downturn. Alternatively, we could define a threshold for each country's growth rate below which the country would be in a downturn. Or, we could establish a threshold for an increase in the rate of inflation. Our basic rationale for choosing negative per capita GDP growth is that it reflects a shrinkage in resources available to maintain the political-economic system. By running a deficit, the government can temporarily forestall a fall in GDP. But if it tries to do this indefinitely without correcting structural imbalances, the economy will eventually collapse. Our measure of downturn captures these types of situations—those that embody severe economic deterioration. It also captures the costly aspects of other variables commonly used for indicating economic crises, such as accelerating inflation and trade and budget deficits. Another advantage of this measure is that it is independent of a country's level of development.

To examine the link between economic downturns and reform attempts, we first identified all reform attempts and downturn episodes for fifteen developing countries from 1972 to 1991. We plotted per capita GDP growth rates over time for the fifteen countries and identified the downturn episodes. For example, the years 1982 and 1983 represent a downturn episode for Chile (figure 1). Having identified and listed all episodes, we then determined whether each reform attempt could be classified as a response to a downturn. For a reform attempt to qualify as a response to a downturn, we imposed the condition that it had to occur reasonably close to the beginning of a downturn. More specifically, the declaration of the attempt and at least preliminary actions had to have taken place either during a downturn period or within a year from the end of the downturn period.

Examples of downturns and reforms identified in Malaysia and Ghana demonstrate how we identified reform attempts and classified them as responses or nonresponses to downturns.[4] The examples also show the difficulties inherent in deciding which incidents constitute separate reform episodes and whether they are responses to particular downturns.

MALAYSIA. During the 1970s and early 1980s Malaysia's public enterprise sector grew rapidly under the New Economic Policy, which had been adopted in 1970 to expand the wealth and earning opportunities of the country's politically dominant but economically weak Bumiputra population. The number of public

4. Basic information about the other countries in our sample is available from the authors upon request. It can be examined in greater detail to assess the appropriateness of labels assigned to the episodes.

Figure 1. *Growth Rate of Gross Domestic Product per Capita, Chile, 1971–92*
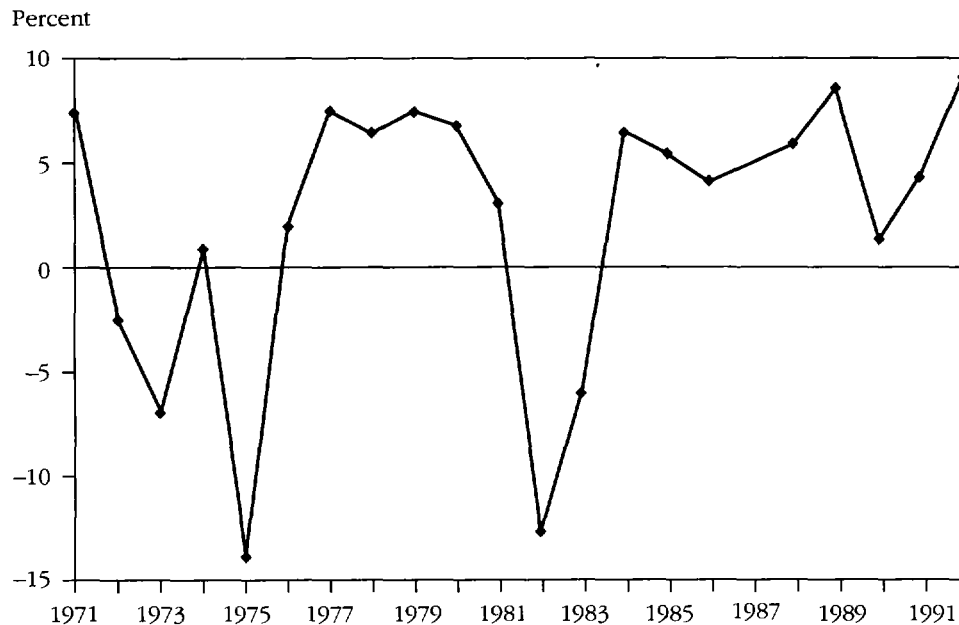
Percent

Source: World Bank (1994b).

enterprises grew from 109 in 1970 to 1,014 in 1985. Government investment in them grew from 32 percent of the development budget during the period from 1966 to 1970 to 56 percent during the period from 1981 to 1985. Meanwhile, the Malaysian economy was growing rapidly, except for 1975 and 1985–86, when the per capita growth rate turned negative. These downturn periods were associated with declines in the terms of trade that reduced export earnings and government revenues. The first downturn came when the public enterprise sector was still relatively small. At the time, the New Economic Policy relied mostly on imposing weak employment and ownership quotas on private firms to achieve its objectives. Shortly after the downturn the government tried to strengthen the quota enforcement, but backed off when the business community objected to the pressures. Instead, the government decided to rely more on the expansion of public enterprises to further the goals of the New Economic Policy (Bowie 1991). In our data set we counted this incidence as an episode of downturn without reform.

After 1976 the government quickened the pace of establishing companies in which the Bumiputra were given privileged positions as workers, managers, and institutional or individual equity owners. When the costs of this strategy began to mount in the early 1980s, the controversies about the role of public enterprises grew stronger. But no action was taken until 1985–86, when a terms-of-

trade shock combined with the growing inefficiency of the public enterprises gave rise to another economic downturn. In 1986 the government largely abandoned the objective of redistributing rents through public enterprises and shifted its focus to growth (Bruton 1992). As part of a major reform, public enterprises were made more autonomous by decentralizing decisionmaking. The budgets of public enterprises that did not perform well were cut, and in many cases their managers were fired (Means 1991). In many major enterprises, Bumiputra managers were replaced by domestic minority or foreign managers (Bowie 1991). A number of public enterprises were placed under management contract, and some public enterprises were prepared for privatization, although few were actually privatized (Sundaram 1993). We qualified this as a downturn episode that led to an attempt at public enterprise reform.

The post-1986 policy process followed a steady pace until 1991, when the government announced a Privatization Masterplan along with three other major programmatic documents outlining Malaysian economic development policy for the foreseeable future. Soon privatization gained momentum, and within two years the market value of privatized firms reached 29 percent of Kuala Lumpur Stock Exchange capitalization (Sundaram 1993). The new policy was instituted even as the country continued to experience vigorous economic growth. Although from 1986 to 1991 many steps were undertaken to prepare the ground for increased privatization, the Masterplan reflected a major shift in Malaysia's economic policy to remove government ownership as a means of directing the economy. We counted this episode as a case of reform attempt without downturn.

Finally, it should be noted that the expansion of the public enterprise sector and later reforms in Malaysia were carried out under very stable political conditions. The same party has been in power since independence, and since 1970 the premiership has changed hands only twice, in 1976 and in 1981, with the deputy prime minister moving to the position of power in both cases.

GHANA. During the late 1960s and early 1970s the Ghanaian government limited public ownership to approximately fifty public enterprises that had been formed during the 1950s and early 1960s. In 1972 the economy experienced a major decline following a terms-of-trade shock and a military coup. The junta shifted the government's policy toward rapid expansion of the public enterprise sector. Even when another terms-of-trade shock precipitated a 15 percent decline in per capita GDP in 1975 and an additional 5 percent decline in 1976, the government continued to extend the role of public enterprises and follow other expansionary policies (Gyimah-Boadi 1993). We classified both incidents as downturns without reform.

In the second half of the 1970s, extensive rent extraction and redistribution by the government seriously damaged the Ghanaian economy such that even the sources of rent dried up (Leith and Lofchie 1993). The economy was so weak that it could not deal with the decline in the secular terms of trade, which began in 1978—per capita GDP fell precipitously from1979 to 1983. In 1979 a coup by

junior military officers, led by Jerry Rawlings, helped transfer power to an elected civilian government. But neither the coup makers nor the civilian government did much to reform public enterprises except for mounting an anticorruption campaign and shuffling some public enterprises from one supervisory organization to another (Gyimah-Boadi 1993). This approach also persisted for about a year after Rawlings regained power with a second coup in December 1981. But as exports and government revenues continued to fall precipitously, political leaders began to shift their position in favor of market-oriented policies.

In 1983 the government adopted an Economic Recovery Program to rehabilitate the economy through extensive liberalization, which consisted of macroeconomic, trade, and public expenditure reforms. After an initial emphasis on stabilization and trade liberalization, the government attended to the problems of the public sector. In 1984 public enterprises were allowed to raise their product prices, while hiring of new workers in the sector was frozen, and a job retrenchment plan was introduced. The government also ordered a study of 100 public enterprises that were to be prepared for privatization.

In 1985, performance contracts were set up for the managers in a number of public enterprises, and a task force was formed to compile a package of deeper public enterprise reforms. The program developed by the task force finally resulted in the advertisement of thirty-two public enterprises for sale in mid-1988. By 1993, eighty-six public enterprises had been or were being divested, thirty-two of which were cases of liquidation (World Bank 1993). Meanwhile the political situation has remained stable, and the economy has responded well to the reform measures, maintaining a positive growth rate (averaging 1.76 percent from 1984 to 1992) despite a continued terms-of-trade decline.

We considered the economic decline of the early 1980s and the policy changes in the mid-1980s to be an episode of downturn with a reform response. The reform was slow to materialize, and its implementation has been problematic; but there is little doubt that a reform attempt did begin around 1983–84. We could have counted the divestiture program in the second half of the 1980s as a separate reform attempt, but an examination of the history of Ghana's Economic Recovery Program suggested to us that divestiture was part of the original plan, each stage of which was carried out slowly.

Empirical Analysis

Examining all of the downturn episodes identified in the sample, we see that almost 80 percent of reform attempts (nineteen out of twenty-four) were preceded by economic downturns. Moreover, the five reforms that took place without downturns occurred in situations in which the country strongly met the structural and trade-orientation criteria for reform readiness (see table 1 and the following discussion). Therefore, although this evidence is limited to fifteen countries, it suggests that for most developing countries, economic downturn may be an almost necessary condition for public enterprise reform. But it is clear from figure 2 that downturns are by no means a sufficient condition: only

Figure 2. *Public Enterprise Reform Responses to Economic Crisis*


```
                    ┌─────────────────────────────────┐
                    │        Did the country have     │
                    │        an economic crisis?      │
                    │  YES (47 cases)      NO (5 cases)│
                    └─────────────────────────────────┘
                         │                      │
                         ▼                      ▼
        ┌──────────────────────────┐  ┌──────────────────────────┐
        │   Did the country implement │ │ Did the country implement │
        │   public enterprise reforms? │ │ public enterprise reforms? │
        │                              │ │                            │
        │ YES (19 cases)  NO (28 cases)│ │        YES (5 cases)       │
        └──────────────────────────┘  └──────────────────────────┘
            │              │                         │
            ▼              ▼                         │
```

Argentina	1988
Chile	1972, 1975, 1982
Egypt	1992
Ghana	1979
India	1991
Malaysia	1985
Mexico	1982, 1986, 1988
Nigeria	1986
Pakistan	1993
Philippines	1983, 1991
Senegal	1983
Turkey	1979, 1991
Venezuela	1989

Argentina	1975, 1978, 1981, 1985
Ghana	1972, 1975
India	1971, 1974, 1976, 1979
Indonesia	1982
Korea, Rep. of	1980
Malaysia	1975
Nigeria	1972, 1975, 1978, 1981
Pakistan	1971
Senegal	1971, 1973, 1977, 1980, 1989, 1991
Turkey	1989
Venezuela	1971, 1974, 1978

Indonesia	1986
Korea, Rep. of	1984
Malaysia	1991
Pakistan	1977, 1990

Source: World Bank data; Bruton (1992); Gyimah-Boadi (1993); Haggard and Webb (1994); Leith and Lofchie (1993); Means (1991); Sundaram (1993); Wade (1990); Waterbury (1993); Williamson (1994).

40 percent of downturns were followed by public enterprise reforms. Note that our observations do not change significantly if attention is restricted to the post-1978 period, when market-oriented policies gained wider acceptance: there were thirty-one downturn episodes, seventeen of which were associated with one of the twenty-one reform attempts (table 1).

Can characteristics of downturns or structural and trade orientation variables explain why some downturns led to attempts at reform but others did not? To answer this question, we undertake a probit analysis of reform attempts conditional on the occurrence of an economic downturn. To operationalize this analysis, we assign numbers (1 through 47) to the downturn episodes that we have identified and then define a dummy dependent variable, y_i:

$$y_i = 1, \text{ if downturn } i \text{ resulted in a reform attempt}$$
$$0, \text{ otherwise.}$$

We relate y_i to six variables listed in table 1. The first three right-hand-side variables (in the fourth, fifth, and sixth columns) reflect the role of the economy's structure: respectively, the five-year average ratio of public investment to total investment (RPI) prior to each downturn episode, the five-year average share of nonagricultural sectors in GDP (SNA) prior to each episode, and an interaction term between RPI and SNA ($RPI \times SNA$). We expect an increase in SNA or RPI to raise the likelihood that a regime will attempt a public enterprise reform and an increase in their interaction to reduce the likelihood. That is, we expect positive coefficients for RPI and SNA but a negative coefficient for $RPI \times SNA$.

The fourth explanatory variable (in the seventh column in table 1) is an index of the outward orientation of trade policy (TO) prior to each downturn episode. It is based on Dollar's (1992) cross-country real exchange rate comparisons. This index assigns a ranking of 0 through 3 to each observation, with 0 indicating the most inward-oriented set of policies and 3 the most outward-oriented set. Since Dollar provides only average ranking for the period from 1976 to 1985, we adjusted the ranking up or down over time according to changes in trade policy whenever a significant policy change could be detected. We expect the coefficient of TO to be positive since outward orientation increases the likelihood of a reform attempt.

The fifth variable (in the third column of table 1) is the magnitude of downturn (MD), which we define as the cumulative decline in GDP over the length of the downturn. For instance, suppose a country's per capita GDP falls by 5 percent in year t, then by 7 percent in year $t + 1$, and then 3 percent in year $t + 2$. The magnitude of this downturn would be 15 percent. To the extent that the decline in GDP per capita tends to reduce available rents for redistribution through public enterprises, this variable should measure the strength of incentives to initiate reform. Therefore, we hypothesize that the probability that a regime will attempt a reform increases with the magnitude of the downturn.

Finally, in the last column (table 1) we introduce the level of GDP per capita in constant 1987 U.S. dollars ($GDPPC$) to control for the level of development. This variable is an example of many country characteristics that may be correlated with the first five variables and may influence the reform decision in ways that cannot be determined a priori. We limited our experimentation with such variables to keep enough degrees of freedom for the probit model. As far as the

impact of *GDPPC* on the probability of reform is concerned, higher GDP per capita can facilitate reform (because the general level of development may reflect institutional capacity and commitment capability) or render reform unnecessary (because the ability to produce a high income may indicate the country's success in reducing public enterprise inefficiencies).

The model that we test is the following:

$$y_i = 1 \text{ if } z_i + e_i > 0 \text{ and } y_i = 0 \text{ if } z_i + e_i \leq 0 \text{ , where}$$

$$z_i = a_0 + a_1 SNA_i + a_2 RPI_i + a_3 RPI_i \times SNA_i + a_4 TO_i + a_5 GDPPC_i + a_6 MD_i + e_i$$

and e_i is a random term with a mean of zero. The function z_i is the reform-readiness function. Note that $\text{Prob}(y_i = 1) = \text{Prob}(z_i + e_i > 0)$, that is, the higher the value of z_i, the more reform ready country i is and, thus, the greater is the likelihood that country i will attempt a public enterprise reform when a downturn occurs.

Because there are repeated observations from each country, the e_i's cannot be assumed to be identically and independently distributed. But it is also difficult to disentangle the complex correlation matrix of this term for the sample. To examine the seriousness of this problem, we repeated the exercise with the sample of thirty-one episodes during the period from 1978 to 1993. Since this sample has fewer observations per country, a major difference in the estimates obtained from the two samples could be taken as an indication that the results are unreliable. We also experimented with a sample that excluded three episodes (Chile 1972–73, Chile 1982–83, and the Philippines 1983–85) in which the economic downturn was itself a partial cause of expansion in the number of enterprises under government ownership. In these cases privatization may be seen as a return to normal conditions, and the reform decision may have a different motivation than in other episodes. But the statistical results proved robust to these and similar changes in the sample (compare tables 2 and 3 with tables 4 and 5).

We also investigated the effects of defining our episodes somewhat differently. We divided the time period 1978–93 into two equal subperiods, 1978–85 and 1986–93. We selected all the subperiods in which a downturn occurred and formed our dependent variable, y_i, on the basis of whether the subperiod contained a public enterprise reform episode or not. For the downturn-reform episodes, we used the average over the five-year period preceding the beginning of the downturn for each of the independent variables. For the downturn with no reform episodes, we used the average for the subperiod. No fundamental changes resulted from this perturbation.

The frequency distribution of predicted, compared with actual, outcomes for the full and post-1978 samples is similar, suggesting that the estimates are not very sensitive to the correlation matrix of the error term (tables 2 and 3). The model has a decent fit since 85 percent of the outcomes can be predicted on the basis of the right-hand-side variables. Moreover, the coefficient estimates gen-

Table 2. *Probit Estimation Results for the Full and Post-1978 Samples*

Equation	Constant	Ratio of public to total investment (RPI)[a]	Share of nonagriculture in GDP (SNA)[a]	Interaction term (RPIxSNA)	Trade orientation (TO)[b]	GDP per capita (thousands of 1987 U.S. dollars) (GDPPC)	Magnitude of downturn (MD)	Log-likelihood
Full sample								
1	−42.026	56.777	51.674	−67.560	1.1084	−1.8361	1.1119	−15.28326
	(−2.589)	(2.327)	(2.466)	(−2.169)	(−2.386)	(2.617)	(0.322)	
2	−42.363	57.982	52.187	−69.041	1.0924	−1.8105		−15.33486
	(−2.641)	(2.426)	(2.522)	(−2.261)	(2.626)	(−2.394)		
3	−24.101	29.231	31.773	−35.185		−1.4649		−20.92167
	(−2.720)	(2.199)	(2.673)	(−2.013)		(−2.930)		
4	−14.282	19.640	13.207	−18.057	0.94625			−20.08399
	(−2.282)	(1.719)	(1.787)	(−1.238)	(3.194)			
Post-1978 sample								
5	−37.311	53.696	46.671	−65.271	0.85159	−1.4714	−1.226	−13.84862
	(−2.175)	(2.046)	(2.080)	(−1.925)	(1.960)	(−1.937)	(−0.313)	
6	−36.642	51.828	45.607	−62.744	0.89165	−1.4937		−13.89815
	(−2.143)	(2.023)	(2.047)	(−1.901)	(2.119)	(−1.948)		
7	−26.335	34.798	35.338	−43.914		−1.3694		−16.94097
	(−2.262)	(2.020)	(2.271)	(−1.930)		(−2.422)		
8	−11.757	18.430	11.202	−18.626	0.87505			−16.77872
	(−1.669)	(1.416)	(1.326)	(−1.103)	(2.520)			

Note: The dependent variable is the public enterprise reform dummy, y_r. *t*-ratios are in parentheses. The full sample (1972–93) has forty-seven observations, and the post-1978 sample (1978–93) has thirty-one observations.

a. Values represent the five-year average.

b. Values follow Dollar's (1992) index, which assigns a ranking of 0 through 3 to each observation, with 0 indicating the most inward-oriented set of policies and 3 the most outward-oriented set.

Source: Authors' calculations.

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Table 3. *Frequencies of Actual and Predicted Outcomes for the Full and Post-1978 Samples*

	Full sample			Post-1978 sample		
	Predicted			Predicted		
Actual	0	1	Total	0	1	Total
0	25	3	28	11	3	14
1	5	14	19	4	13	17
Total	30	17	47	15	16	31

Note: Results are from equation 2 for the full sample and from equation 6 for the post-1978 sample (see table 2). The predicted outcome has maximum probability. The full sample (1972–93) has forty-seven observations, and the post-1978 sample (1978–93) has thirty-one observations.

Source: Authors' calculations.

erally have the expected signs and display high statistical significance. The predicted probabilities of reform (reported in the last column of table 6) also show that the model identifies reform-ready conditions with reasonable accuracy. The only unexpected result is the insignificant coefficient of *MD*. The reason for this may be that *MD* does not reflect the relevant characteristics of downturns, which are important in triggering reform. We made some attempts to examine this possibility by including in the model changes in the rate of inflation and budget and trade deficits during the downturns. But neither variable was significant. The negative coefficient of GDP per capita could not be predicted a priori. The finding suggests that higher-income countries are less likely to engage in public enterprise reform, either because there are more resources to be redistributed as rents or because there are fewer gains to be made from reform.

To test the robustness of our probit model, we tried to predict the reform readiness of countries that attempted a reform without a downturn. These reform episodes were not included in the estimation sample because that estimation was conditional on the occurrence of a downturn. But our framework would suggest that to attempt reform without experiencing a downturn, a country must be ready for reform so that no additional impetus is needed. Therefore the data from these episodes should generate high positive values for the reform-readiness function and, thus, high predicted reform probabilities. Of the five cases of reform without downturn that we investigated, four have a positive z_i and predicted reform probabilities greater than 0.85 (table 6). Moreover, in those four cases the values of z_i are all higher than 1.10, which is the average z_i for all reforms associated with downturns. In fact, only 38 percent of the reforms associated with downturns had a z_i higher than 1.1 (table 6). Thus it seems that the model predicts reform readiness reasonably well in these cases, and in this sense does identify important preconditions for reform.

Dissecting the measure of reform readiness into its components can provide information as to why in one situation a country attempts to reform while in a different situation the same country or another does not. In order to simplify

Table 4. *Probit Estimation Results for the Reduced Full Sample*

Equation	Constant	Ratio of public to total investment (RPI)[a]	Share of nonagriculture in GDP (SNA)[a]	Interaction term (RPIxSNA)	Trade orientation (TO)[b]	GDP per capita (thousands of 1978 U.S. dollars) (GDPPC)	Magnitude of downturn (MD)	Log-likelihood
1	−39.897 (−2.518)	55.253 (2.324)	48.58 (2.368)	−65.071 (−2.145)	1.043 (2.554)	−1.5945 (−2.060)	−0.59938 (−0.152)	−14.61944
2	−39.805 (−2.499)	54.732 (2.314)	48.47 (2.350)	−64.48 (−2.132)	1.0524 (2.589)	−1.6171 (−2.114)		−14.63109
3	−23.204 (−2.532)	28.143 (2.065)	30.08 (2.446)	−33.137 (−1.851)		−1.3403 (−2.597)		−20.34340
4	−14.497 (−2.226)	20.534 (1.717)	13.27 (1.718)	−19.008 (−1.242)	0.92175 (3.107)			−17.98100

Note: The dependent variable is the public enterprise reform dummy, y_i. The reduced full sample has forty-four observations. Three episodes are excluded from the full sample: Chile 1972–73 and 1982–83 and the Philippines 1983–85. t-ratios are in parentheses.

a. Values represent the five-year average.

b. Values follow Dollar's (1992) index, which assigns a ranking of 0 through 3 to each observation, with 0 indicating the most inward-oriented set of policies and 3 the most outward-oriented set.

Source: Authors' calculations.

Table 5. *Frequencies of Actual and Predicted Outcomes for the Reduced Full Sample*

Actual	Predicted		Total
	0	1	
0	25	3	28
1	5	11	16
Total	30	14	44

Note: Results are from equation 2 (see table 2). The predicted outcome has maximum probability. The reduced full sample has forty-four observations. As explained in the text, the observations for Chile (1972–73 and 1982–83) and for the Philippines (1983–85) are excluded.

Source: Authors' calculations.

this analysis, for each episode in table 6 we present the product of the right-hand-side variables of the probit model and their estimated coefficients (from equation 2 of table 2). In the sixth column of table 6 we also show the value of $a_0 + a_1 SNA_i + a_2 RPI_i + a_3 RPI_i \times SNA_i$, which measures the net impact of structural variables on the reform-readiness function. We call this component structural reform readiness to distinguish it from the effect of trade orientation and per capita income. The higher the value of this measure, the more predisposed a country is toward attempting a reform, given the level of GDP per capita and trade orientation.

Structurally, reform-ready countries are those that by virtue of their relatively large nonagricultural or public sectors can gain significantly from public enterprise reform. These countries may delay reform if their incomes are high and their economies are inward oriented, for example, Argentina and Venezuela, or if they do not experience a downturn to trigger reform, for example, Egypt. Interestingly, Argentina, Venezuela, and Egypt have initiated reforms as their circumstances have changed. Egypt experienced a downturn in the early 1990s. Argentina and Venezuela, after repeated incidents of downturn, ended up with much lower per capita incomes. They have also reoriented their trade policies. Comparing the experiences of these two countries with those of Chile and Mexico, which have been more active reformers, is interesting because the four countries were structurally similar, but Chile and Mexico had lower initial incomes and greater outward orientation.

Most countries that did not reform despite repeated economic downturns were those that lacked structural reform readiness. For example, Nigeria in the 1970s had relatively small nonagricultural and public sectors compared with the rest of the sample. Its relatively closed economy also reduced the impetus for public enterprise reform. But in the 1980s when the size of Nigeria's public sector increased sharply and its nonagricultural sector expanded, a downturn led to a reform attempt. Ghana, India, and Senegal have had similar experiences. But India's and Senegal's increased openness to international trade con-

tributed to reform readiness, and in Ghana a major expansion in the relative size of the public sector was the main contributory factor. It is interesting to observe that the inclusion of trade orientation and GDP per capita substantially affects the coefficients of the structural variables. The reason is that *RPI* and *SNA* are correlated with trade orientation and GDP per capita. Indeed, regressions of explanatory variables on each other based on our sample show that *RPI* is negatively (and significantly) related to both trade orientation and GDP per capita, while *SNA* is positively (and significantly) related to both variables. This confirms the common view that to reach higher levels of income, economies must become increasingly nonagricultural and open and must reduce their reliance on the public sector. It also supports our arguments that outward orientation is complementary to a large nonagricultural private sector and helps trigger reform when structural reform readiness is high.

The above discussions are not meant to give the impression that the results of our model are definitive. Certainly, the model can be refined by incorporating more explanatory variables, especially institutional characteristics and disaggregated structural measures. There is also a need to develop appropriate tests to deal with possible alternative hypotheses explaining the relationships we found in our empirical analysis. Nevertheless, the exercise shows that the model helps explain why reform did or did not occur in each situation, and establishes a practical way of assessing a country's readiness for reform. Moreover, when a country does not meet the preconditions for reform, the model shows how that may change as a result of changes in country characteristics.

III. CONCLUSIONS

Initiating reform in a country's public sector is a complex decision. It may be influenced by economic and political conditions, as well as other circumstances, such as the ideological biases and personalities of political leaders. Nonetheless, our theoretical and empirical analyses suggest that important generalizations based on a contracting framework could be made. By tracing the impact of a number of variables reflecting the conditions of the economy on the costs and benefits of renegotiating public enterprise policies, we presented evidence that reform is more likely under the following circumstances:

- *When the economy experiences an adverse shock.* Public enterprise rents decline, redistribution is less costly, and gains from reform may in fact increase.
- *The larger the size of the nonagricultural sector.* Public enterprises and the rest of the economy are more interlinked so that potential gains from reform are higher.
- *The larger the size of the public sector relative to the size of the economy.* The public sector is more likely to include activities for which the efficiency gains swamp the costs of redistribution.

Table 6. *Reform-Readiness Assessments in Sample Countries: Contributions of Each Variable to Reform-Readiness Function, z*

Country	Years	Constant	Ratio of public to total investment (RPI)[a]	Interaction term (RPI×SNA)	Share of nonagriculture in GDP (SNA)[a]	Structural reform readiness[b]	GDP per capita (thousands of 1978 U.S. dollars) (GDPPC)	Trade orientation (TO)	Reform readiness	Prob(y_i = 1)
Downturn episodes without reform										
Argentina	1975–76	−42.36	21.81	−23.88	47.99	3.55	−6.60	0.00	−3.05	0.00
	1978	−42.36	22.95	−25.09	47.91	3.41	−6.78	0.00	−3.37	0.00
	1981–82	−42.36	22.69	−24.82	47.93	3.44	−6.85	1.09	−2.31	0.01
	1985	−42.36	14.26	−15.50	47.64	4.04	−6.53	1.09	−1.40	0.08
Ghana	1972	−42.36	26.53	−14.57	24.06	−6.33	−0.95	0.00	−7.28	0.00
	1975–76	−42.36	32.73	−17.50	23.43	−3.70	−0.93	0.00	−4.63	0.00
India	1971–72	−42.36	22.15	−14.67	29.02	−5.86	−0.44	0.00	−6.30	0.00
	1974	−42.36	24.24	−16.54	29.91	−4.76	−0.44	0.00	−5.19	0.00
	1976	−42.36	24.40	−16.86	30.29	−4.54	−0.44	1.09	−3.88	0.00
	1979	−42.36	25.15	−17.81	31.03	−3.99	−0.46	2.18	−2.27	0.01
Indonesia	1982	−42.36	25.22	−21.95	38.14	−0.95	−0.62	2.18	0.61	0.73
Korea, Rep. of	1980	−42.36	12.67	−11.86	41.00	−0.55	−3.01	3.28	−0.27	0.39
Malaysia	1975	−42.36	18.24	−15.34	36.85	−2.61	−2.02	3.28	−1.35	0.09
Nigeria	1972	−42.36	19.31	−11.49	26.07	−8.47	−0.68	0.00	−9.15	0.00
	1975	−42.36	27.14	−17.27	27.90	−4.60	−0.71	0.00	−5.32	0.00
	1978	−42.36	35.76	−25.38	31.11	−0.88	−0.77	0.00	−1.65	0.05
	1981–84	−42.36	39.00	−30.23	33.97	0.38	−0.77	0.00	−0.39	0.35
Pakistan	1971–72	−42.36	28.70	−21.53	32.88	−2.31	−0.40	2.18	−0.53	0.30
Senegal	1971	−42.36	32.03	−27.34	37.41	−0.26	−1.31	0.00	−1.57	0.06
	1973	−42.36	26.41	−23.17	38.46	−0.67	−1.31	0.00	−1.98	0.02
	1977–78	−42.36	28.66	−24.79	37.91	−0.58	−1.29	0.00	−1.87	0.03
	1980–81	−42.36	29.50	−25.79	38.32	−0.34	−1.28	0.00	−1.62	0.05
	1989	−42.36	19.04	−17.82	41.01	−0.13	−1.22	2.18	0.84	0.80
	1991	−42.36	18.68	−17.44	40.91	−0.21	−1.23	1.09	−0.34	0.37
Turkey	1989	−42.36	31.37	−30.39	42.45	1.07	−2.22	2.18	1.04	0.85

Venezuela	1971–72	−42.36	13.86	−15.68	49.58	5.40	−5.97	0.00	−0.57	0.28
	1974–75	−42.36	18.76	−21.24	49.62	4.78	−5.87	0.00	−1.09	0.14
	1978–85	−42.36	21.22	−24.05	49.66	4.47	−5.94	1.09	−0.38	0.35

Downturn episodes with reform

Argentina	1988–90	−42.36	15.64	−17.01	47.66	3.93	−6.26	2.18	−0.14	0.44
Chile	1972–73	−42.36	28.21	−30.96	48.11	2.99	−2.62	1.09	1.46	0.93
	1975	−42.36	36.03	−39.72	48.32	2.26	−2.57	2.18	1.88	0.97
	1982–83	−42.36	18.71	−20.45	47.92	3.81	−2.67	2.18	3.32	1.00
Egypt	1992	−42.36	34.96	−33.25	41.68	1.03	−1.34	1.09	0.79	0.78
Ghana	1979–83	−42.36	44.89	−25.63	25.02	1.92	−0.82	0.00	1.10	0.86
India	1991	−42.36	26.44	−21.41	35.49	−1.84	−0.62	2.18	−0.28	0.39
Malaysia	1985–86	−42.36	26.71	−24.86	40.80	0.28	−3.28	3.28	0.28	0.61
Mexico	1982–83	−42.36	24.58	−26.67	47.54	3.10	−3.32	3.28	3.05	1.00
	1986	−42.36	23.10	−25.18	47.78	3.33	−3.53	3.28	3.08	1.00
	1988	−42.36	20.04	−21.79	47.66	3.55	−3.37	3.28	3.46	1.00
Nigeria	1986–87	−42.36	42.44	−34.26	35.38	1.20	−0.61	0.00	0.59	0.72
Pakistan	1993	−42.36	28.24	−25.04	38.86	−0.30	−0.64	3.28	2.33	0.99
Philippines	1983–85	−42.36	17.67	−16.15	40.05	−0.79	−1.21	2.18	0.18	0.57
	1991–92	−42.36	10.39	−9.50	40.06	−1.41	−1.09	2.18	−0.31	0.38
Senegal	1983–84	−42.36	21.50	−19.76	40.29	−0.34	−1.22	1.09	−0.46	0.32
Turkey	1979–80	−42.36	26.80	−25.34	41.44	0.54	−1.88	1.09	−0.25	0.40
	1991	−42.36	28.63	−28.03	42.90	1.14	−2.36	2.18	0.96	0.83
Venezuela	1989	−42.36	24.14	−27.04	49.08	3.82	−4.79	1.09	0.12	0.55

Reform episodes without downturn

Indonesia	1986	−42.36	26.95	−23.97	38.98	−0.40	−0.72	3.28	2.16	0.98
Korea, Rep. of	1984	−42.36	14.12	−14.11	43.79	1.44	−3.61	3.28	1.10	0.86
Malaysia	1991	−42.36	22.51	−21.27	41.42	0.29	−3.73	3.28	−0.16	0.44
Pakistan	1977	−42.36	34.62	−27.27	34.52	−0.49	−0.40	2.18	1.30	0.90
	1990	−42.36	30.58	−26.85	38.48	−0.15	−0.59	3.28	2.53	0.99

a. Values represent the five-year average.

b. This is the value of $a_0 + a_1 SNA_i + a_2 RPI_i + a_3 RPI_i \times SNA_i$, which measures the net impact of structural variables on reform readiness, that is, the value of z_i.

Source: Authors' calculations.

- *The smaller the (multiplicative) product of the relative size of the nonagricultural sector and the public sector.* In a nonagricultural economy, redistribution is more complex, and the informational obstacles to reform tend to be greater when most of the economy is under public ownership.
- *If the economy is more outward oriented.* Efficiency gains are likely to be larger when producers face more elastic demands in international markets and there is a larger constituency demanding reduction in the costs of public enterprise inefficiency.
- *If the per capita income is lower.* Controlling for other factors, high-income countries are likely to have either larger resources for redistribution or reduced public enterprise inefficiency as a result of implementing appropriate solutions in the past.

Despite its inevitable shortcomings, our analytical and empirical framework for analyzing the determinants of public enterprise reform yields a reasonably robust model with strong predictive powers. It also has some important policy implications. In particular, it suggests that foreign aid may dampen the impetus for reform. Foreign aid affects the reform decision in two ways. First, it alleviates the impact of an economic downturn, and second, it acts as a brake on the fall in per capita income. Consequently, even countries that might be structurally reform-ready may opt to postpone introducing reforms. But the model also suggests that trade liberalization may strengthen the impetus for reform. This implies that making trade liberalization a condition for receiving aid may neutralize the dampening effect of aid. Aid can also be directly conditioned on public enterprise reform measures. This of course requires that the imposition of conditionality be credible. The advantage of conditionality on trade liberalization rather than on public enterprise reform is that donors are more likely to have a direct interest in the maintenance of liberal trade and, thus, respond to violations of the conditions.

APPENDIX: SELECTION OF VARIABLES

We began this research with an extensive literature review. Perhaps the predominant theme that came up was that economic crises drove economic reforms. Hence we decided to follow the logic of the argument through the logic of our model and test the hypothesis. We needed a variable that represented a crisis—and chose to use a downturn in the growth rate. From a long list of variables that could conceivably affect the costs and benefits of undertaking public enterprise reform, we focused first on the division of activities between the public and private sectors. We argued that if a country has already reformed its public enterprise sector and cut it down in size, the country should have less to gain from further reform. When public enterprises are confined to a few enterprises with significant public good and natural monopoly elements, the economy is unlikely to gain a great deal from their reform since the size of the
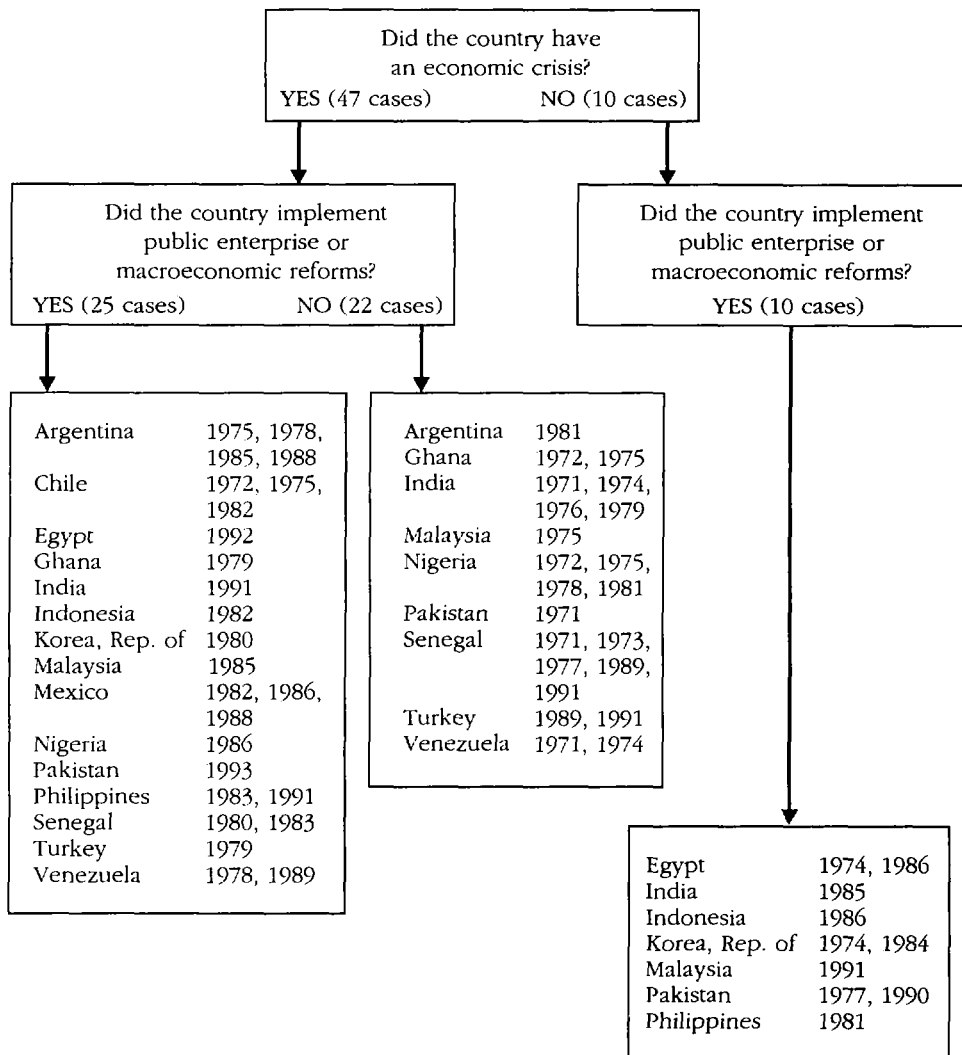
sector is small and, moreover, these characteristics are likely to cause problems for any form of sectoral organization, public or private. To capture this effect, we chose the ratio of public to total investment (*RPI*). The larger the public enterprise sector, the larger would be the ratio, and the larger the potential gains from reform.

But we recognized that the relationship may not be simple. From the privatization literature we knew that a developed domestic private sector can facilitate privatization through its financial resources, entrepreneurship, and ability to collect information and assess public enterprises that are sold. As the experience of Eastern European countries suggests, if the entire economy operates under public enterprises, knowledge and experience about how a market-oriented system (especially private firms) operates and information about who might benefit are scarce, and this scarcity makes reform difficult and costly. Therefore, we needed a measure of the part of the private sector that could be helpful for public enterprise reform. We thought an appropriate indicator was the relative size of the nonagricultural private sector, $(1 - RPI)SNA$, where *SNA* is the share of the nonagricultural sector in GDP. Our initial regressions indicated that both variables were significant and had positive coefficients.

Next, we focused on the informational attributes of the economy, which, as implied by our theoretical framework, could be an important determinant of the cost of undertaking a reform. We understood that privatization is only one type of public enterprise reform and concluded that the nonagricultural private sector may be particularly important for its informational role. We also needed a measure of informational requirements. Here we thought that an indicator of the economy's complexity, such as diversity of production, would be appropriate. *SNA* seemed to capture this notion and was included in the regression as a separate independent variable. We then saw that the three terms could be re-written as *RPI* and *SNA* with an interaction between the two signifying the role of information, hence the final form in which they are presented in the model. To these terms, we added the trade orientation variable to capture the need to enhance the competitiveness of the economy, as well as the government's commitment to market-oriented reforms. GDP per capita was introduced to control for whatever influence other country characteristics associated with the level of development might have. Finally, we toyed around with different measures of economic crisis, such as changes in the inflation rate and budget deficit, but our experimentation suggested that these were not very useful.

Figure A-1. *Public Enterprise/Macroeconomic Reform Responses to Economic Crisis*

```
                        ┌─────────────────────────────────────┐
                        │         Did the country have         │
                        │         an economic crisis?          │
                        │                                       │
                        │  YES (47 cases)        NO (10 cases)  │
                        └─────────────────────────────────────┘
                             │                        │
                             ▼                        ▼
        ┌──────────────────────────────┐   ┌──────────────────────────────┐
        │    Did the country implement │   │    Did the country implement │
        │        public enterprise or  │   │        public enterprise or  │
        │     macroeconomic reforms?   │   │     macroeconomic reforms?   │
        │                              │   │                              │
        │ YES (25 cases)  NO (22 cases)│   │         YES (10 cases)       │
        └──────────────────────────────┘   └──────────────────────────────┘
             │             │                            │
             ▼             ▼                            ▼
```

Argentina	1975, 1978, 1985, 1988
Chile	1972, 1975, 1982
Egypt	1992
Ghana	1979
India	1991
Indonesia	1982
Korea, Rep. of	1980
Malaysia	1985
Mexico	1982, 1986, 1988
Nigeria	1986
Pakistan	1993
Philippines	1983, 1991
Senegal	1980, 1983
Turkey	1979
Venezuela	1978, 1989

Argentina	1981
Ghana	1972, 1975
India	1971, 1974, 1976, 1979
Malaysia	1975
Nigeria	1972, 1975, 1978, 1981
Pakistan	1971
Senegal	1971, 1973, 1977, 1989, 1991
Turkey	1989, 1991
Venezuela	1971, 1974

Egypt	1974, 1986
India	1985
Indonesia	1986
Korea, Rep. of	1974, 1984
Malaysia	1991
Pakistan	1977, 1990
Philippines	1981

Source: World Bank data; Bruton (1992); Gyimah-Boadi (1993); Haggard and Webb (1994); Leith and Lofchie (1993); Means (1991); Sundaram (1993); Wade (1990); Waterbury (1993); Williamson (1994).

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Roads, Land Use, and Deforestation:
A Spatial Model Applied to Belize

Kenneth M. Chomitz and David A. Gray

Rural roads promote economic development, but they also facilitate deforestation. To explore this tradeoff, this article develops a spatially explicit model of land use and estimates probabilities of alternative land uses as a function of land characteristics and distance to market using a multinomial logit specification of this model. Controls are incorporated for the endogeneity of road placement.

The model is applied to data for southern Belize, an area experiencing rapid expansion of both subsistence and commercial agriculture, using geographic information system (GIS) techniques to select sample points at 1-kilometer intervals. Market access, land quality, and tenure status affect the probability of agricultural land use synergistically, having differential effects on the likelihood of commercial versus semisubsistence farming. The results suggest that road building in areas with agriculturally poor soils and low population densities may be a "lose-lose" proposition, causing habitat fragmentation and providing low economic returns.

The loss of tropical forests is a global concern because of its impact on biodiversity and climate. Roads are viewed as having precipitated much of this loss by opening forest areas to logging and agricultural conversion. This view poses a dilemma: road construction has traditionally been one of the most important tools for rural development (Creightney 1993) and, moreover, is thought to favor the rural poor (Lipton and Ravallion 1995). It is therefore important to quantify the impact of road building on both deforestation and development in order to assess the severity of the tradeoff between environmental preservation and economic growth.

Although planners are aware of the deleterious effect of roads on forests, they have no empirical guidance on the extent and nature of that damage. How far from the road do conversion effects extend? What kind of conversion is induced? Whom does it benefit? In this article we propose a model that addresses these questions. Following von Thünen (1966), we hypothesize that land

is devoted to the use that generates the highest potential rent. Roads play an important role in determining rent—and thus land use—by affecting agricultural output and input prices. But we hypothesize that the impact of roads will be strongly modulated by other factors affecting rent, including soil quality and distance from markets. If our hypothesis is correct—that road impacts are modulated by local conditions—then it may be possible to locate roads so as to spur development while minimizing induced deforestation.

Our goal is to develop a spatially explicit framework for testing this hypothesis. Spatially explicit models are appropriate for two reasons. First, they exploit rich spatial variation in variables of interest—variation that is obscured in aggregate data (for example, district-level means). Second, location matters. In general, we are interested not just in the physical extent of deforestation, but also the degree to which it affects critical habitats and watersheds.

The model we present uses spatially disaggregated data, controls for a wide variety of land and soil characteristics, employs multiple land-use categories, and is embedded in an economic framework. The model is estimated using 1989–92 data from Belize. Still mostly forested, Belize is of great interest for conservation because of its rich biodiversity and of its relatively large tracts of contiguous forest. Despite its small size, Belize exhibits many different deforestation processes, including encroachment by swidden agriculturalists and forest conversion to pasture, citrus groves, and large mechanized farms. In addition, Belize has superb documentation of land use and land characteristics, which facilitates this kind of study.

I. Issues and Analyses of Roads, Land Use, and Deforestation

Qualitatively, the impacts of roads on forests are clear. New roads offer market access for timber and agricultural products from previously remote areas. Roads also lower the costs of migration, land access, and land clearing for subsistence farmers. In sum, road construction into forested areas unambiguously increases the incentives to log those territories or convert them to other uses.

But the extent of deforestation hinges on the magnitude of those incentives, which we hypothesize to vary systematically over the landscape. Consider the following issues in regional and environmental planning:

- *Road siting and regional development.* Schneider (1995) and others have suggested that road building should be intensive rather than extensive. That is, road development should stress the creation of dense road networks around market centers rather than the extension of roads into areas with low population densities. Although this proposition seems to be reasonable, we lack information about the relative environmental costs and development benefits of the two strategies. Is road intensification a "win-win" strategy— that is, does it boost output and reduce environmental damage compared with an extensification strategy? What are its distributional implications?

The significance of these questions is underlined by the rapid expansion of road networks in the tropical world. In the 1980s, Brazil's paved road network grew from 87,000 kilometers to 161,500 kilometers, and Indonesia's from 56,500 kilometers to 116,500 kilometers (World Bank 1994). A recent review of Sub-Saharan Africa's rural roads concluded that "the present rural road network . . . needs to be increased up to tenfold if the full agricultural potential of the region is to be realized" (Riverson, Gaviria, and Thriscutt 1991).

- *Environmental impact assessment of forest and mining concessions.* According to some authors (Kummer and Turner 1994; Johnson and Cabarle 1993; Barbier and others 1994), logging's indirect impact on deforestation may be greater than the direct impacts of timber removal and collateral damage to standing stock. Forested regions are damaged additionally if logging roads and operations facilitate access by follow-on settlers, who convert the logged-over forest to pasture, permanent crops, or shifting cultivation. Hence, plans for the sustainable management of forest concessions must consider more than just silvicultural issues. Predictive models of follow-on settlement could be employed in environmental impact assessments of proposed logging and mining concessions that entail road building.
- *Conservation planning.* It is expensive to set up and maintain protected areas. Conservation planners have long recognized the need to establish an index of the threat of conversion to help prioritize candidate areas for protection. Such indexes have been constructed as ad hoc functions of population density or prior conversion, for example. But without behavioral grounding, these indexes may not be very accurate. Past deforestation rates, for instance, may be poor predictors of current rates if road networks have changed. Cross-sectional variation in population densities usually reflects differences in soil quality and may bear no relation to incentives for deforestation. Much more desirable would be a methodology that assesses actual deforestation incentives. This methodology could be used to design conservation policies that seek to alter these incentives.

In sum, quantitative models of land use and land-use change could be applied in a variety of environmental planning purposes. But to be useful, quantitative studies must meet several criteria. First, they must be based on spatially disaggregated data. Second, they must incorporate a wide range of land-use determinants, while recognizing that population distribution, road placement, and land-use change are jointly determined. Third, they must be based on an economic framework.

Few studies on developing countries meet all these criteria. A limited literature uses provincial- or district-level data to analyze patterns of deforestation. Alig (1986), Panayotou and Sungsuwan (1989), and Barbier and Burgess (1994) emphasize the role of prices in determining land use. The latter two studies include both prices and road accessibility in their analyses, but their estimates of

net road impacts do not include the indirect impacts of roads through their effect on farmgate prices. Reis and Margulis (1991), Reis and Guzmán (1994), Southgate, Sierra, and Brown (1991), and Pfaff (1996) focus on the effects of roads, cattle, and population on deforestation. The latter two studies are noteworthy for attempting to deal with the endogeneity of population distribution.

Studies using large administrative areas as the unit of observation are inherently limited in their ability to discern how far across the landscape a road's impact stretches or to detect the impact of variations in soil quality on land use. Only a handful of studies use spatially disaggregated data. Liu, Iverson, and Brown (1993), writing on the Philippines, show that there is a strong inverse relationship between distance from the road network (as of 1941) and proportion of forest lost from 1934 to 1988. This suggestive bivariate relationship, however, may reflect the influence of other variables, such as soil fertility or market proximity. Three studies apply multivariate techniques to spatially disaggregated data. A study of Thai farmers by Fox and others (1994) uses a multinomial logit model to examine the determinants of crop choice among plots already converted to cultivation. Chomitz and Gray (1995) (a predecessor to this article) use an economic framework to derive a similar multinomial logit specification, extending it to include noncultivation as a land-use category. Nelson and Hellerstein (1995) use Chomitz and Gray's framework to examine the impact of road access and village access on land use in a region of central Mexico.
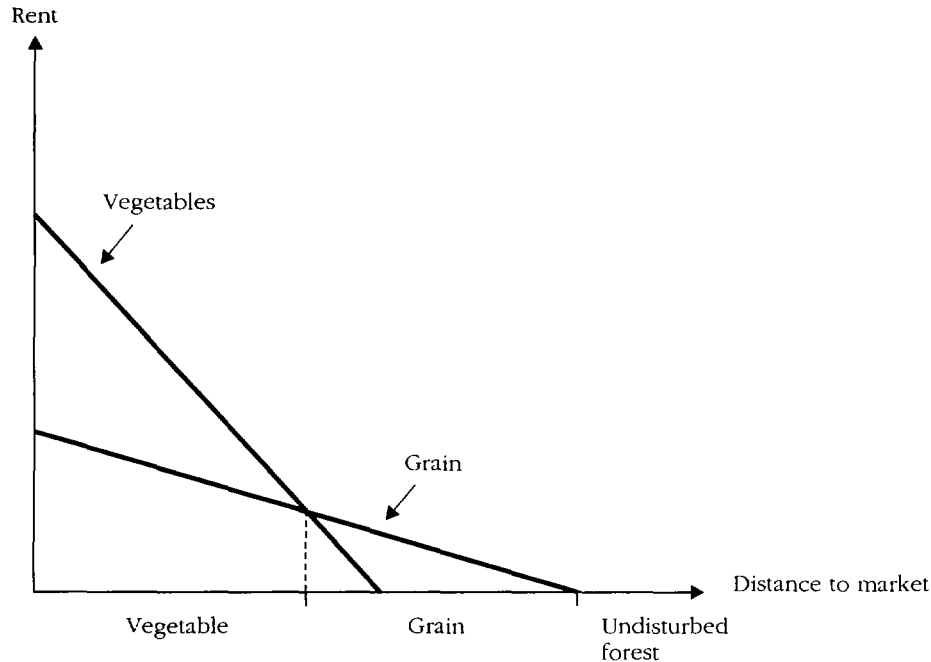
II. A Spatial Model of Land Use

Deforestation is just one aspect of a general model of land use. Below, we derive an estimatable, spatially explicit model of land use based on von Thünen (1966). Theoretical variants have been presented by von Amsberg (1994), Schneider (1995), and Hyde, Amacher, and Magrath (1993).

Following von Thünen, we suppose that there is a potential rent (farmgate value of output minus the cost of inputs) attached to each use of each plot of land. The model predicts, simply, that land will be devoted to the activity yielding the highest rent. In the classic example, farmers working near a city find that vegetables are more profitable to produce than grain (figure 1). Because vegetables are perishable, they are more expensive to transport than grain. Thus at some distance from the city grain becomes more profitable to produce than vegetables. And beyond a certain, even greater, distance the land is undisturbed under its original forest cover.

More formally, let P_{ik} be the price of the output of use k at point i, C_{ik} a vector of prices of inputs to k at that point, X_{ik} the optimal quantities of inputs for k per unit of land, and Q_{ik} the potential output of k at that point. The potential rent associated with devoting plot i to use or commodity k is[1]

(1) $$R_{ik} = P_{ik}Q_{ik}(P_{ik}, C_{ik}) - C_{ik}X_{ik}(P_{ik}, C_{ik}).$$

1. We are assuming a static framework. Dynamic issues are discussed later.

Figure 1. *The von Thünen Model Revisited*

Unfortunately, P, C, and Q are not only endogenous, they are also unobserved. We do, however, observe the determinants of price and of productivity and can therefore formulate a reduced-form model. (All the right-side variables are jointly determined with land use in a spatial equilibrium and are therefore endogenous. Hence, to estimate equation 1 directly, we would have to instrument these variables through auxiliary equations parallel to those used to derive the reduced form.)

Following von Thünen, we assume that spatial differentials in farmgate prices are related solely to differences in transport costs to major markets. For each commodity we can specify functions relating output and input prices to the distance D to market:[2]

$$(2) \qquad P_{ik} = \exp(\gamma_{0k} + \gamma_{1k}D_i)$$

$$C_{ik} = \exp(\delta_{0k} + \delta_{1k}D_i).$$

Conventionally, output prices are assumed to decrease with distance ($\gamma_{1k} < 0$) and input costs to increase ($\delta_{1k} > 0$). The second assumption is very plausible for

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2. For greater flexibility, a polynomial in D could be specified. A linear specification (with truncation at zero) is more traditional. However, transport costs are not necessarily linear in distance. The exponential specification offers greater flexibility, but is used here primarily to permit derivation of an easily estimatable multinomial logit model.

bulk inputs such as fertilizer, but is less clear for labor inputs. There is little information on the spatial structure of wages in forested areas with low population densities. Scattered and anecdotal evidence suggests that the returns to labor are higher at the forest frontier than in areas closer to urban markets (Charras and Pain 1993; Schneider 1995). It is possible, however, in some places that labor costs (and thus, conceivably, total input costs) might decrease with distance from market.

The production function for use k, here expressed as output per unit of land, is assumed to be

$$(3) \qquad Q_{ik} = S_{ik} X_{ik}{}^{\beta_k} \quad [0 < \beta_k < 1].$$

The productivity factor S can be expressed as the product of agroclimatic and other variables, s_i, describing soil fertility and other land characteristics:

$$S_{ik} = \lambda_{0k} s_{1i}^{\lambda_{1k}} s_{2i}^{\lambda_{2k}} \dots$$

From equation 3, we can derive the demand for X (suppressing subscripts for readability):

$$(4) \qquad X = \left[\frac{C}{PS\beta} \right]^{1/[\beta-1]}$$

Substituting equations 3 and 4 into equation 1 (suppressing subscripts and simplifying), we have

$$(5) \quad R = PQ - CX = PSX^{\beta} - CX = X[PSX^{\beta-1} - C] = C^{\beta/(\beta-1)}[PS\beta]^{1/(1-\beta)}(1-\beta)/\beta.$$

Together, equations 4 and 5 show that rent and input intensity increase as output prices increase, and decrease as input costs increase.

Substituting equations 2 and 3 into equation 5, taking logs, reintroducing subscripts, regrouping and simplifying coefficients, and introducing a stochastic error term, we have

$$(6) \qquad \ln R_{ik} = \alpha_{0k} + \alpha_{1k} D_i + \alpha_{2k} \ln(s_{1i}) + \dots + u_{ik} \equiv Z_i A_k + u_{ik}$$

where Z is the vector of independent variables, A is a vector of reduced form parameters, with $\alpha_{1k} = (\gamma_{1k} - \delta_{1k}\beta_{1k})/(1 - \beta_{1k})$, and $\alpha_{2k} = \lambda_{1k}/(1 - \beta_{1k})$.

We expect the coefficients on distance to be negative and those on productivity-enhancing land characteristics to be positive. The magnitude of those coefficients, however, will differ markedly from crop to crop. Bulky commodities should have a large (negative) coefficient on the distance measures. By contrast, farmers who produce mostly for subsistence may care relatively little about distance to market, yielding a coefficient with a small absolute value. It is theoretically possible for $\alpha_{1k} > 0$ in the special case of labor-intensive, high-value/weight commodities when wages decrease with distance to market.

To estimate the model, we assume that land is devoted to the highest-rent use: point i is devoted to use k if

(7) $R_{ik} > R_{ij}$, for all uses $j \neq k$.

If the disturbances u are Weibull distributed and uncorrelated across uses j, then equation 7 is equivalent to a multinomial logit model in which the probability that plot i is devoted to use k is

(8)   Prob (i devoted to k) = $\dfrac{\exp(Z_i A_k)}{\sum\limits_j \exp(Z_i A_j)}$.

The multinomial logit model allows us to estimate the coefficients in equation 6 provided that the coefficients of one use—for example, natural vegetation—are normalized to zero. With normalization, equation 8 can also be expressed as

(9)   ln [prob (i devoted to k)/prob (i devoted to comparison use)] = $Z_i A_k$.

The estimate $Z_i A_k$ can also be interpreted as the relative (but not absolute) rent for use k at location i.

To apply this highly stylized model, we must address a number of practical complications.

- *Road endogeneity.* The model assumes that the placement of the road network is exogenous to agricultural land use. In some applications this assumption is reasonable. For instance, some roads are installed for political reasons, to provide access to a mine site or to connect distant cities. In general, however, road construction and routing may be influenced by agricultural development considerations. If roads are preferentially routed through agriculturally suitable areas and if some aspects of suitability are not observed, then the model may overestimate the effect of distance from the road. A plot of land may be undeveloped not because it is far from the road—it may be far from the road because it is not suitable for development.

  In Chomitz and Gray (1995) we argued that this bias could be reduced by including a variety of soil quality indicators as land-use determinants. A major goal of this article is to apply an instrumental variables approach to control for road endogeneity. As instruments we use variables that are correlated with the measure of market distance, but that are arguably uncorrelated with unobserved determinants of land use (holding constant the observed determinants).

- *Price expectations.* Current land-use decisions depend not only on today's prices, but also on expectations of future prices. A classic example is using deforestation to assert land rights in an area in which land prices are expected to rise (Schneider 1995). Similarly, a transient decline in the price of a tree

crop will not lead to plantation abandonment. Ideally, then, the expected path of future prices should be included as an explanatory variable.

- *Reversibility of land use.* The model assumes that if cultivated land becomes uneconomic (because of a drop in crop prices, for example), it will revert to natural vegetation. This assertion is defensible, even in the short run, as long as "natural vegetation" is broadly defined. If "forest" is distinguished as a separate land use, reversibility would certainly not hold in the short run, since abandoned land takes years to return to forest. For many forest areas, reversibility might be a reasonable assumption in the context of a long-run, static equilibrium model. Large portions of Belize's forest, for instance, were recently leveled by hurricanes. Studies of the Amazonia, too, have shown that most abandoned plots quickly revert to forest (Moran and others 1994), though this is less likely for plots that have been intensively used or scraped by bulldozers (Nepstad, Uhl, and Serrão 1991). It is important to stress, however, that regrowth of forest cover does not necessarily imply maintenance of original biodiversity or carbon levels.

- *Tenure as a determinant of rent.* Equation 5 assumes that landowners will either adopt the highest-rent land use or rent or sell the land to someone else who will do so. But as Schneider (1995) and Hyde, Amacher, and Magrath (1993) have stressed, returns to different land uses depend strongly on tenure. On the frontier, where land rights are poorly defined and difficult to defend, it may not be profitable to invest in perennial crops. But with tenure security, perennials may represent the highest-value use of the land. Similarly, largeholders may refrain from renting out land to sharecroppers— even if sharecroppers enjoy higher returns—if land tenure might be jeopardized. Hence it is desirable to use the land's tenure status as an explanatory variable in equation 3.

- *Correlation of unmeasured influences across commodities.* The multinomial logit model requires that the unobserved effects on the rent for commodity k be independent of the unobserved effects for other commodities at the same point. This is a strong assumption: unmeasured aspects of soil fertility, for instance, may have similar effects on a variety of alternative crops. In future work we will apply a multinomial probit formulation in order to allow for correlation among unmeasured effects.

III. LAND USE IN BELIZE: CONTEXT AND RELEVANCE

Belize is a small country with about 200,000 inhabitants and about 22,000 square kilometers of land area. Less than 10 percent of the land area has been converted to agriculture or settlements, 65 percent is under broadleaf forest, and the remainder consists mostly of swamp, pine forest, and mangrove forest.

Despite its small size, Belize exemplifies many of the issues and circumstances surrounding deforestation. First, the population–forest area ratio, at 9.5 people per square kilometer, is of the same order of magnitude as that in a number of

important forest regions, including Bolivia (14.5), Congo (11.2), and the Brazilian states of Amazonas (1.3) and Pará (4.6). Second, Belize is an important site for wildlife conservation because of its large tracts of contiguous forest and its high level of biodiversity. For example, despite its small size, Belize hosts 528 bird species compared with 650 for the entire United States (WRI 1994).

Third, the forests of Belize are facing increasing pressure from a wide variety of agricultural practices. In this article we focus on the southern part of the country, where rapid population growth among the Maya Indians, together with immigration from neighboring countries, has resulted in the expansion of traditional *milpa* (slash and burn) cultivation of maize for subsistence and rice as a cash crop. At the same time, large-scale farmers—many of them recent Mennonite immigrants—have cleared extensive areas for pasture and for mechanized production of food crops. Citrus cultivation increased rapidly over the 1980s in the study area. Interestingly, timber has been a mainstay of the Belizean economy for more than two centuries, but that industry has not been associated with deforestation because of the highly selective nature of logging.
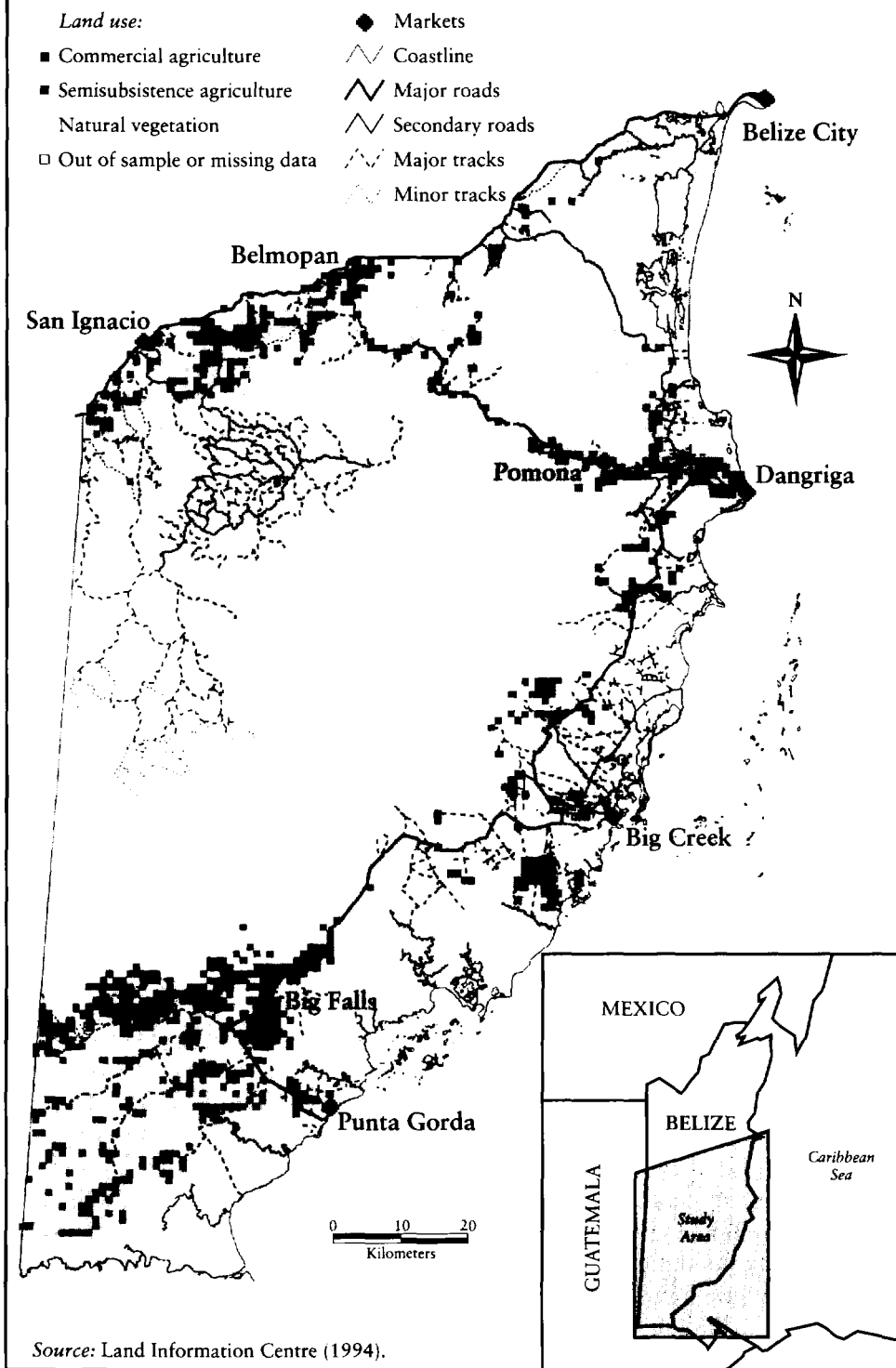
IV. Data and Econometric Issues

We estimate the model defined by equations 6 and 7 using data on a sample of land points. This information is derived from digitally coded maps using geographic information system (GIS) techniques. Sampling was performed by placing a 1-kilometer rectangular grid over the country south of the Western Highway, yielding 11,712 sample points. To visualize the data-extraction process, imagine that we stacked the data layers (maps) of interest. A pin pierces the stack at each sample point, and the mapped information for the point—slope, distance to road, soil quality—is recorded and collated. We excluded national parks and private reserves from our sample, because only five of the 2,147 sample points in these classes were used for agriculture.[3] We also excluded urban and water points. The data layers are briefly described below. For more detailed information, see Chomitz and Gray (1995).

Land-Use Data

We derived the dependent variable from a land cover map (LIC 1994) based on SPOT satellite imagery from 1989 to 1992. Unlike many remote sensing–based land characterizations, this one employed extensive ground-truthing and may be considered highly reliable. The data have a base scale of 1:50,000, and distinguish thirty-one categories of land use/land cover. We aggregated these into three classes: "semisubsistence" agriculture, comprising milpa and other nonmechanized annual cultivation; "commercial farming," comprising mostly pasture and mechanized farming of annuals; and "natural vegetation," comprising forest, secondary regrowth, wetlands, and natural savanna. These land-use labels are for con-

3. In effect, we assign an infinite negative coefficient to an indicator variable for these classes, which is, for all practical purposes, the maximum likelihood estimate.

Map 1. *Land Use in Southern Belize, 1989–92*

Land use:
■ Commercial agriculture
■ Semisubsistence agriculture
  Natural vegetation
□ Out of sample or missing data

◆ Markets
/\/ Coastline
/\/ Major roads
/\/ Secondary roads
/\/ Major tracks
/\/ Minor tracks

Belmopan
San Ignacio
Belize City
Pomona
Dangriga
Big Creek
Big Falls
Punta Gorda

N

0   10   20
Kilometers

MEXICO

BELIZE

Caribbean
Sea

GUATEMALA

Study
Area

Source: Land Information Centre (1994).

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venience only. Almost all of the "natural" vegetation in Belize has been modified by human action at some time in the past. Some of the areas labeled "semisubsistence" include market-oriented smallholders (map 1).

Land Systems and Land Tenure Data

The land systems data describe the soil's physical and chemical characteristics. These data are taken from a series of land resource assessments (King and others 1986, 1989, 1992), which were designed to yield planning information on the land's suitability for alternative crops.

The land resource assessments were based on a combination of aerial photography and field surveys. The methodology involved segmenting the landscape into about 10,000 internally homogenous microregions, based on agricultural potential as predicted from topography, soils, and vegetation. The microregions fall into 350 distinct classifications, called land subunits. These are similar to the land facets commonly associated with the land systems methodology. Each subunit is characterized by a set of physical and chemical descriptors, which in turn are used to assess the land's suitability for each of nineteen agricultural uses. It is important to stress that nutrient values are derived from field sites that are not used for agriculture. These values are then imputed to the same class of land subunits that are under cultivation.

Land in Belize falls into five broad tenure classes: private land, national land, Indian reserves, forest reserves, and protected areas. National land, which is held by the government but is available for lease by individuals, is believed to be more subject to encroachment by subsistence farmers than other tenure categories. The land systems and land tenure variables used in this analysis are as follows (for further details see Chomitz and Gray 1995; King and others 1993: 110–17):

Nitrogen: Soil nitrogen in percent
Slope: Slope in degrees
Available phosphorus: Available phosphorus in parts per million
pH: Soil pH
Wetness: An 8-point ordinal scale for drainage, ranging from 0 (well drained) to 7 (permanently wet)
Flood hazard: Dummy variable for flood hazard
Rainfall: Mean annual rainfall in meters
National land: Dummy for national land
Forest reserve: Dummy for forest reserve

Distance to Markets

Road network data are from a 1:50,000 topographic map series based on 1980s data, updated in certain areas to 1993. (It would have been preferable to recreate the road network as of 1989, the earliest date for the land-use data. We will attempt this in future work, using satellite imagery.) The measurement of

market distance differs here from that used in Chomitz and Gray (1995). The earlier paper distinguished two components of distance: the straight-line distance from a sample point to the nearest point on the road network, and the subsequent on-road travel time to market (adjusted for road quality). This approach had the advantage of letting the estimation procedure yield relative weights for on- and off-road travel. Its disadvantage was that off-road distance was not adjusted for terrain—which varies substantially, from flat to mountainous to swampy.

In this study we compute an integrated distance measure by assigning impedance levels to different types of terrain. The impedances are judgmental estimates of the relative cost of transport. First- through fourth-class roads are assigned impedances of 1 through 4, respectively, representing the approximate inverse ratios of travel speed (60 miles through 15 miles per hour). Dry, level, roadless terrain is assigned an impedance of 100, based on a rough calculation of the relative cost of human-carried transport. More difficult terrain is assigned an impedance of up to 3,000 based on slope and wetness—implying that mountainous and swampy terrain is virtually impassable. To compute the distance from a point to a market, we gridded the landscape into 30-meter cells, assigned an impedance to each cell, and computed the route with the lowest cumulative impedance using standard iterative techniques.

We computed distance to eight markets—Belize City, Belmopan, San Ignacio, Dangriga, Pomona, Big Creek/Independence, Big Fall, and Punta Gorda (map 2). Because of the low impedance assigned to on-road travel, distance to market is strongly related to distance from the nearest road.
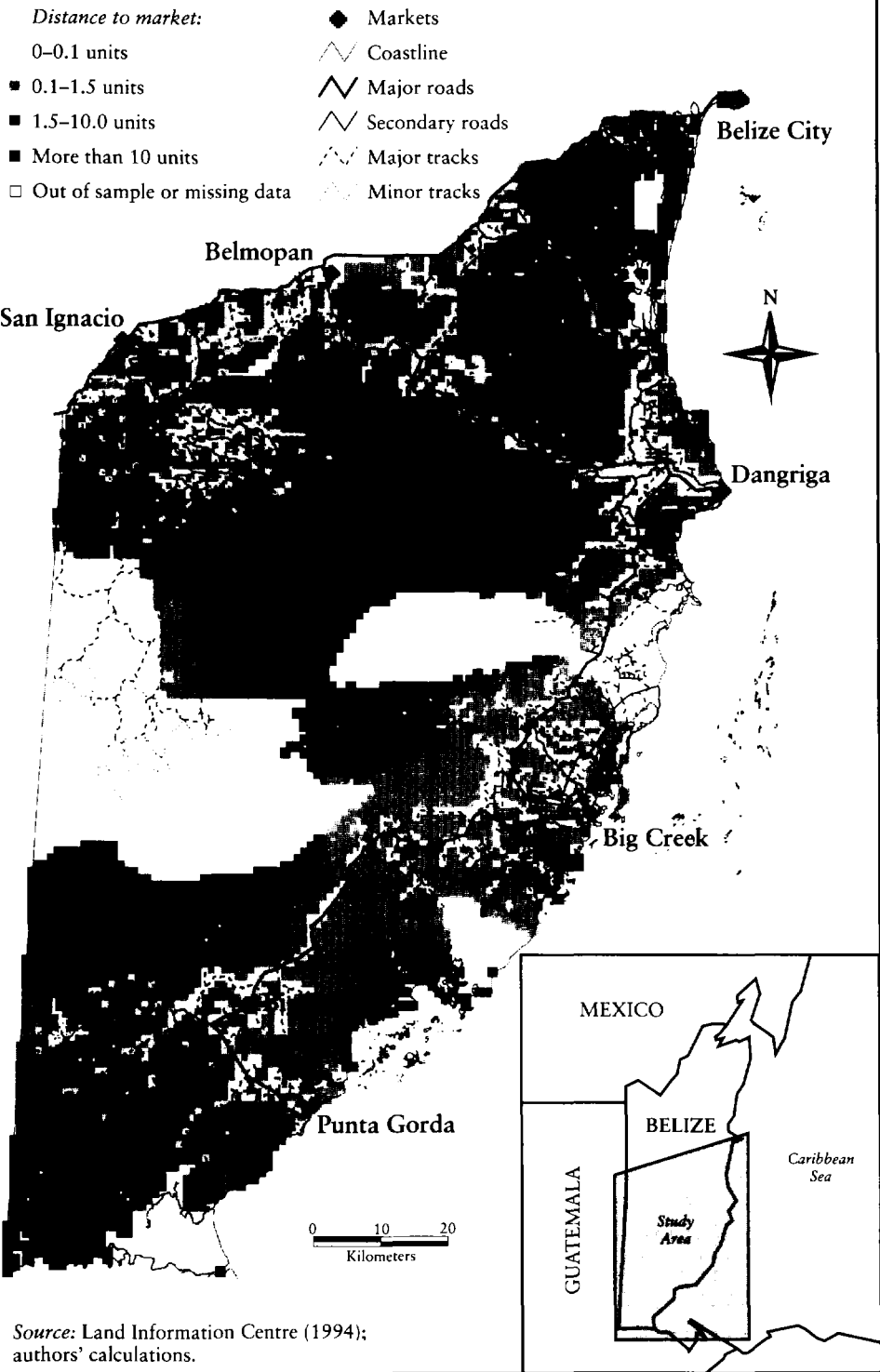
Instruments for Distance

We calculated an accessibility measure in the same fashion as distance, only we calculated it as if there were no roads. That is, impedances for road cells were set to the impedance of the underlying terrain. This measure is strongly correlated with distance but is uncorrelated with unmeasured characteristics of a point's soil fertility, and thus constitutes an instrument for distance. The accessibility measure does, however, take market locations as exogenously given. This is a reasonable assumption in many cases—many of the towns in Belize started as logging or trading sites rather than as agricultural centers. The assumption is most problematic in the case of the citrus processing plant at Pomona, but even there the plant predated and influenced the massive citrus expansion of the 1980s. Additional instruments are provided by the mean and standard deviation of soil fertility measures within a 5-kilometer radius of the sample point. Holding constant its own soil fertility, a point is more likely to be served by roads if it is in a fertile area.

Spatial Autocorrelation

Land characteristics are likely to be characterized by spatial autocorrelation: places that are near to each other will tend to have similar soil types, rainfall,

Map 2. *Integrated Cost Distance to Market, Southern Belize*

Distance to market:

0–0.1 units

● 0.1–1.5 units

■ 1.5–10.0 units

■ More than 10 units

□ Out of sample or missing data

◆ Markets

Coastline

Major roads

Secondary roads

Major tracks

Minor tracks

Belize City

Belmopan

San Ignacio

N

Dangriga

Big Creek

MEXICO

BELIZE

Caribbean Sea

GUATEMALA

Study Area

Punta Gorda

0   10   20

Kilometers

Source: Land Information Centre (1994); authors' calculations.

and so on. Some of these characteristics may not be observable. The resulting spatial autocorrelation of disturbance terms (the u_{ik} in equation 4) is the two-dimensional analog of more familiar patterns of autocorrelation in time-series models. In general, it results in inefficient parameter estimates and inaccurate measures of statistical significance, although consistency in limited dependent variable models requires our maintained hypothesis of homoskedasticity (McMillen 1992). We use a bootstrapping procedure to estimate the standard errors of the coefficients. We constructed 100 replicates of the data set by sampling with replacement, estimated the model on each replicate, and computed the standard deviations of the coefficients.

V. ESTIMATION RESULTS

In order to pursue the instrumental variables approach, we used exogenous variables to predict distance to market. For each market, the natural log of the distance measure was regressed on the natural log of the distance instrument, the mean and standard deviation of soil nitrogen within a 5-kilometer radius of the sample point, and the set of agroclimatic and tenure variables to be used in the land-use equation. All equations had an R^2 between 0.64 and 0.68, with t-statistics for the distance instrument ranging from 43 to 63. The mean of nitrogen was never statistically significant, but the standard deviation of nitrogen was strong and generally significant at the 0.001 level. The point-specific soil fertility variables generally had strong, highly significant effects in the predicted direction. A 0.1 percentage point increase in nitrogen was associated with a 24 to 33 percent reduction in the distance measure, and wetness and slope increased the distance measure. The flood hazard dummy was associated with a shorter distance measure, presumably because of its association with river valleys forming natural transportation corridors. The expected antilog of the predicted natural log (distance) was used as an explanatory variable in the multinomial land-use estimation.

Multinomial Logit Results

In the multinomial logit estimation using both actual and predicted distance measures (table 1; table 2 reports descriptive statistics) land use is aggregated into three classes: natural vegetation (the comparison class, with coefficients normalized to zero); semisubsistence agriculture; and commercial agriculture (comprising both citrus and large-scale agriculture). The relevant market is taken to be the nearest of the eight towns in the study area.

The two sets of estimates agree closely. The coefficients on market distance are lower in absolute magnitude using predicted distances—as expected—but only by 10 to 12 percent. Most of the other coefficients are reasonably robust. The two estimates yield very similar predictions: the correlation between the two predictions for natural vegetation probability is 0.96. This figure suggests that inclusion of soil quality variables is sufficient to eliminate most bias from

road endogeneity. The following discussion will therefore employ the predictions based on actual distance. It is also noteworthy that bootstrap estimates of standard errors differ little from the standard estimates.

The estimates show that both semisubsistence and commercial agriculture become less attractive as distance to market increases, as expected. Commercial agriculture is much more sensitive to distance—a result that was not obvious a priori. Semisubsistence farmers market only a fraction of their production, so they might be expected to be insensitive to distance. On the other hand, large farms producing cattle or feed for integrated poultry production might also be insensitive to distance.[4] An alternative specification in which we assumed commercial farming to be oriented only to Belize City, rather than the nearest town, fit the data poorly. The predicted probability of commercial farming increased with distance to Belize City, reflecting the observed clustering of commercial farming around the smaller towns. We hypothesize that distance to the nearest market affects cropping at least partly through its effect on labor: farmers, both commercial and subsistence, are unwilling to live far from roads or towns.

Land and soil characteristics strongly affect the probability of agricultural use. Higher soil nitrogen boosts the probabilities of both types of agriculture, but has a far stronger effect on semisubsistence agriculture. Nitrogen is relatively more important for semisubsistence farmers, either because of differing crop mixes or (more likely) because of credit constraints in purchasing fertilizer. Both types of agriculture are encouraged by phosphorus and discouraged by an excessively low or high pH. These results are consistent with anthropological findings that traditional farmers use a variety of pedological and botanical cues to assess soil quality with considerable accuracy (see Carter 1969 on Maya farmers in Guatemala; Wilken 1987 on Mexican and Guatemalan farmers; and Moran 1993 on Brazilian farmers). The flood hazard dummy, a likely indicator of riverside location, strongly boosted the likelihood of semisubsistence farming but had a small, insignificant effect on the likelihood of commercial farming. Slope discourages commercial farming but encourages semisubsistence farming. National land has a low probability of commercial cultivation, but a high probability of semisubsistence cultivation, suggesting that these lands are subject to encroachment. Zoned forest reserves, however, have very low relative probabilities of agricultural use, all else equal.

Our principal conclusion is that market distance, land quality, and tenure have strong interactive effects on the likelihood and type of cultivation (figure 2). The top panel of figure 2 shows cultivation probabilities as a function of distance to market for the Cayo Floodplains land type, which is characterized

4. Because citrus is far more sensitive to transport than other commercial crops, an alternative, four-land-use class model was also run. Citrus was distinguished from other types of commercial agriculture, and its market was assumed to be the processing plant at Pomona. As expected, citrus was found to be extremely sensitive to distance (with a coefficient of −8.0), but the remaining components of commercial agriculture were still more sensitive to distance than semisubsistence agriculture (with coefficients of −1.6 and −0.60). Soil quality coefficients for citrus were implausible and unstable because of the small number of citrus sample points. These results are available from the authors on request.

Table 1. *Multinomial Logit Estimates of Land Use, Belize*

Variable	Using actual distances				Using predicted distances		
	Coefficient	Standard error	Standard error (bootstrap)	z-statistic (bootstrap)	Coefficient	Standard error	z-statistic
Commercial agriculture							
Distance to market	−2.2553	0.2704	0.4543	−4.96	−1.9914	0.3007	−6.62
Soil nitrogen (percent)	5.1638	1.4776	1.1999	4.30	3.0062	1.4820	2.03
Slope (degrees)	−0.0173	0.0087	0.0092	−1.89	−0.0169	0.0098	−1.73
Available phosphorus (parts per million)	0.0429	0.0079	0.0068	6.32	0.0383	0.0077	5.00
Soil pH	1.4898	0.7917	0.7589	1.96	1.0133	0.7533	1.35
Soil pH squared	−0.1469	0.0739	0.0715	−2.05	−0.1041	0.0699	−1.49
Wetness[a]	−0.4606	0.1079	0.0949	−4.85	−0.4875	0.1057	−4.61
Wetness squared	0.0804	0.0179	0.0167	4.81	0.0775	0.0180	4.30
Flood hazard (dummy variable)	0.0901	0.1760	0.1672	0.54	−0.0736	0.1798	−0.41
Rainfall (annual mean in meters)	−0.3225	0.1262	0.1155	−2.79	−0.1437	0.1330	−1.08
National land (dummy)	−0.7175	0.1670	0.1691	−4.24	−0.6905	0.1649	−4.19
Forest reservation (dummy)	−3.2072	0.3917	0.4543	−7.06	−2.7627	0.3986	−6.93
Constant	−5.0524	2.1499	2.0037	−2.52	−3.7037	2.0347	−1.82

Semisubsistence agriculture

Distance to market	−0.6002	0.0759	0.0921	−6.52	−0.5497	0.0980	−5.61
Soil nitrogen (percent)	16.8863	1.4455	1.3419	12.58	16.8703	1.4523	11.62
Slope (degrees)	0.0355	0.0073	0.0075	4.75	0.0335	0.0074	4.52
Available phosphorus (parts per million)	0.0421	0.0078	0.0094	4.49	0.0396	0.0077	5.17
Soil pH	2.3188	1.0439	1.1978	1.94	2.4429	1.0332	2.36
Soil pH squared	−0.1838	0.0974	0.1142	−1.61	−0.1935	0.0961	−2.01
Wetness[a]	1.0536	0.1497	0.1734	6.08	1.0430	0.1493	6.99
Wetness squared	−0.2188	0.0253	0.0308	−7.11	−0.2182	0.0254	−8.60
Flood hazard (dummy variable)	0.9188	0.1515	0.1611	5.70	0.8385	0.1505	5.57
Rainfall (annual mean in meters)	0.2749	0.0949	0.0989	2.78	0.3087	0.0990	3.11
National land (dummy)	0.7229	0.1089	0.1090	6.63	0.7623	0.1111	6.86
Forest reservation (dummy)	−1.8958	0.2210	0.2289	−8.28	−1.5904	0.2354	−6.76
Constant	−13.9614	2.7433	3.0562	−4.57	−14.4196	2.7233	−5.29
Log likelihood		−2,290				−2,360.4	
Number of observations		9,017				9,017	

Note: Natural vegetation is the comparison class (with coefficients normalized to zero). The relevant market is taken to be the nearest of the eight towns in the study area.

a. Wetness is calculated on an 8-point scale for drainage, ranging from 0 (well drained) to 7 (permanently wet).

Source: Authors' calculations.

Table 2. *Descriptive Statistics of Land Use, Belize*

Variable	Mean	Standard deviation	Minimum	Maximum
Distance to market	3.1884	4.7253	0.0004	24.7614
Nitrogen	0.1360	0.0498	0	0.2
Slope	16.3389	15.7382	0	40
Available phosphorus	5.2633	7.1391	2	31.5
pH	5.3180	0.9587	3.5	7.625
pH squared	29.2004	10.6575	12.25	58.1406
Wetness	1.7144	2.1941	0	7
Wetness squared	7.7530	12.6117	0	49
Flood hazard	0.4025	0.4904	0	1
Rainfall (meters)	2.3040	0.6186	1.025	4.046
Forest reservation	0.4628	0.4986	0	1
National land	0.2013	0.4010	0	1

Note: For description of variables, see section IV of the article.
Source: Authors' calculations.

by high phosphorus, moderate nitrogen, and low pH. This combination favors commercial agriculture. At the market there is a 34.4 percent chance that the land is converted to commercial agriculture use but only a 1.4 percent chance that it is used for semisubsistence cultivation. The remainder is under natural vegetation. The probability of commercial cultivation declines markedly with distance, however, so that at distance index = 1 (far from roads), commercial agriculture declines to 5.3 percent; it essentially vanishes if distance doubles.

The middle panel of figure 2 predicts use of land typical of the Toledo Uplands, with high nitrogen and moderate slope, which favors semisubsistence agriculture. On this type of land, if the plot was adjacent to a market, the probability of semisubsistence cultivation would be 45.4 percent, compared with 5.0 percent for commercial agriculture. Note that the probability of semisubsistence use declines only gradually as distance to market increases, implying substantial cultivation even far from the road. This figure refers to current cultivation, and does not include the probability that land is in the fallow cycle of a shifting cultivation system.

The bottom panel of figure 2 shows predictions for land classified as Palmasito Plain. This poor-quality land has low nitrogen, low pH, and moderate slope. Even if adjacent to a market, such land would have only a 9.2 percent probability of being cultivated.
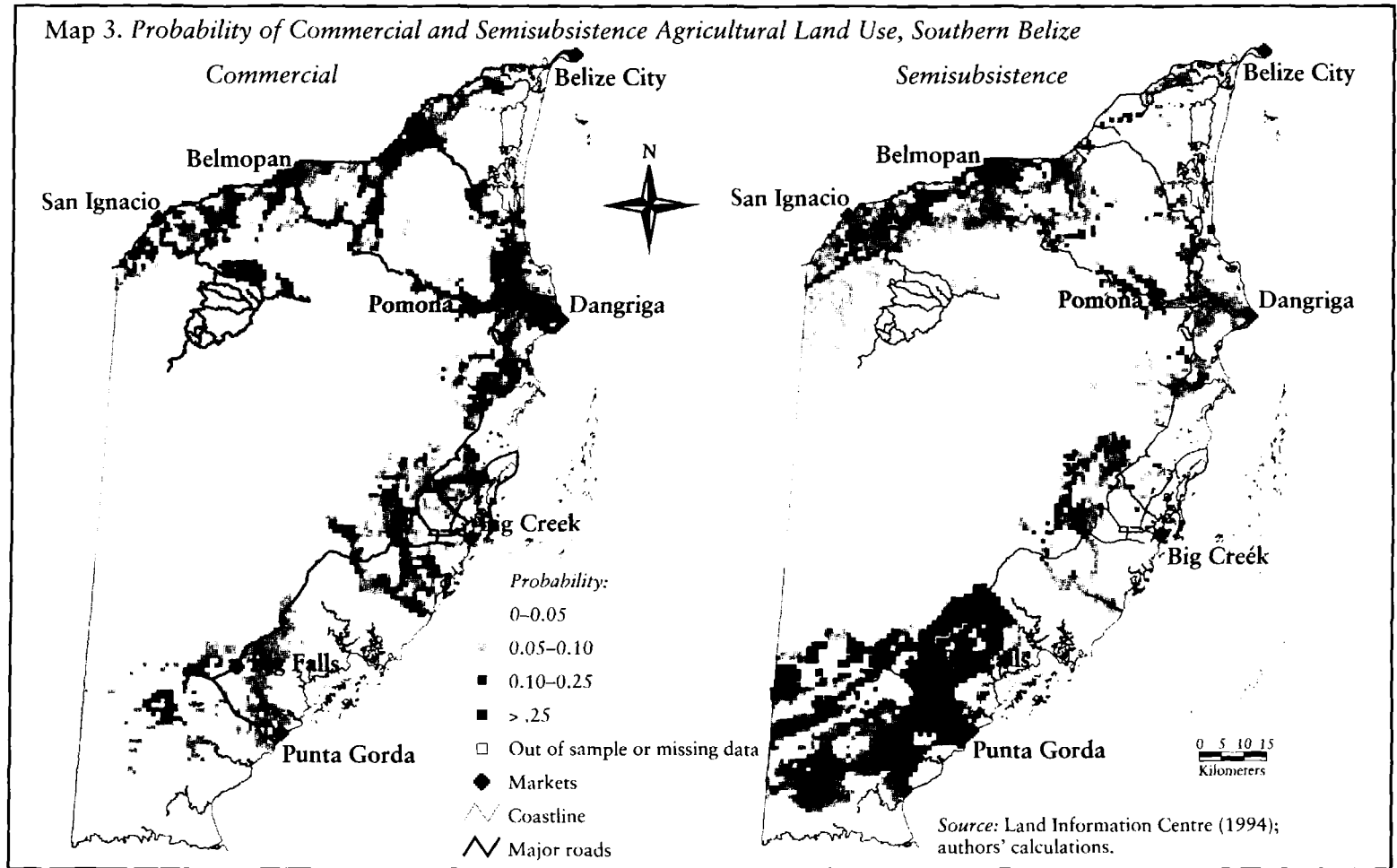
Predictive Ability of the Model

Qualitatively, the predicted probability of cultivation for commercial and semisubsistence agriculture (map 3) closely resembles actual land-use patterns shown in map 1. The model does not predict that particular points will have a very high probability of agricultural use. Rather, it predicts that entire areas are predisposed, with each individual point having a modest probability of cultivation. Is this fuzziness a vice or a virtue? It is a vice if it reflects the omission of

Figure 2. *Predicted Land-Use Probabilities, Belize*

Cayo Floodplains (terrace)

Toledo Uplands (hillslopes)

Palmasito Plain (rolling plateau)

▨ Commercial ■ Semisubsistence

Source: Authors' calculations.

Map 3. *Probability of Commercial and Semisubsistence Agricultural Land Use, Southern Belize*

Commercial

Belize City

Belmopan

San Ignacio

N

Pomona
Dangriga

g Creek

Probability:

0–0.05

0.05–0.10

■ 0.10–0.25

■ > .25

□ Out of sample or missing data

◆ Markets

Coastline

Major roads

Falls

Punta Gorda

Semisubsistence

Belize City

Belmopan

San Ignacio

Pomona
Dangriga

Big Creek

Punta Gorda

0 5 10 15
Kilometers

Source: Land Information Centre (1994); authors' calculations.

important information that would differentiate the agricultural suitability of neighboring points. It is a virtue if neighboring points are in fact very similar in agricultural suitability. In that case it is truly a matter of chance which points are currently under cultivation. Thus the indication in map 3 of a broad southern area predisposed to semisubsistence agriculture may show the full range of the shifting cultivation system, including formerly cultivated areas now under forest fallow.

Assessing the model's predictive accuracy depends on two choices. The first is a rule for translating predicted land-use probabilities into discrete land-use category predictions. The conventional rule is to choose the category with the highest predicted probability. We argue, however, that even cultivation probabilities predicted to be low carry important information. We therefore suggest an alternative categorization rule: a point is predicted to be natural vegetation if the predicted probability of natural vegetation is greater than the sample mean probability (0.905). Otherwise, the prediction is assigned to the cultivation category with the highest predicted probability.

The second choice in assessing predictive accuracy is the relative tolerance of type-I and type-II errors. We can trivially achieve 90.5 percent overall predictive accuracy by predicting that all points are natural vegetation: all natural vegetation points would be correctly predicted, and all other points would be erroneously classified. Using our criterion, the model's overall accuracy is lower, at 73.6 percent, correctly classifying 74.1 percent of the natural vegetation points. However, it correctly classifies 68.8 percent of cultivated points and misclassifies only 12.5 percent of them as natural vegetation (table 3). These and subsequent predictive assessments exclude natural parks and private reserves. If we included these points and followed the rule that all such points are predicted to be under natural vegetation, the model's overall predictive performance would be much improved. Moreover, there may be meaning in these misclassifications. Some natural vegetation points are actually secondary growth or thicket, indicating recent cultivation and abandonment. Of these points, 48 percent were predicted to be under cultivation, compared with 25 percent of other natural vegetation points.

VI. POLICY APPLICATIONS AND FUTURE RESEARCH

The methodology described here can help planners assess the severity of environment-development trade-offs posed by road extension. We have shown that the impact of roads is highly sensitive to soil quality and to tenure regulations. Some new roads will favor forest clearing for commercial crops, while others will stimulate the spread of shifting cultivation. In the latter cases the planner may be faced with difficult choices—forest preservation, development, poverty alleviation—depending on the characteristics of the farming systems in question. But road extensions into many areas with poor or mediocre soil—which dominate tropical areas—could constitute a lose-lose strategy. The economic return to such roads might be low, given the modest conversion rates that they

Table 3. *Predicted and Actual Land Use, Belize*

	Predicted land use			
Statistic	*Commercial agriculture*	*Semi-subsistence*	*Natural vegetation*	*Actual land use*
Commercial agriculture				
Number of sample points	185	85	39	309
Percentage of actual sample points	60	28	13	100
Percentage of total predicted sample points	17	5	1	3
Semisubsistence agriculture				
Number of sample points	76	407	69	552
Percentage of actual sample points	14	74	13	100
Percentage of total predicted sample points	7	23	1	6
Natural vegetation				
Number of sample points	857	1,258	6,041	8,156
Percentage of actual sample points	11	15	74	100
Percentage of total predicted sample points	77	72	98	90
Total				
Number of sample points	1,118	1,750	6,149	9,017
Percentage of actual sample points	12	19	68	100
Percentage of total predicted sample points	100	100	100	100

Note: This assessment excludes natural parks and private reserves.

Source: Authors' calculations.

will stimulate. And even relatively small amounts of conversion along the road corridor can result in habitat fragmentation, threatening the viability of some populations. This is of particular concern because recent ecological studies suggest that tropical forests based on poor soils have higher levels of biodiversity than those based on good soils (Huston 1994). In addition, road access would expose the forest to various forms of degradation, such as overextraction of mahogany or poaching of birds.

At first glance, these results appear to be obvious. We believe, however, that the exercise is useful on three counts. First, it was not clear a priori that an economic model would be successful in describing the landscape. Second, the results for semisubsistence cultivation, though plausible, were not obvious a priori. Many observers believe that subsistence farmers are insensitive to soil conditions and will thus colonize along any available roadway. To the contrary,

we found that in the low population-density context of Belize, subsistence farmers shun poor-quality land and are moderately sensitive to market access. This finding suggests that the hypothesis that logging causes damage primarily by inducing follow-on migration along logging roads does not necessarily apply to remote, low population-density areas with poor soils. Finally, the methodology presented yields quantitative results. This information can in turn be used to help assess environmental impacts and economic benefits.

The model has shortcomings that we hope to correct in future work. First, the assumptions underlying the multinomial logit specification are strong—they will be relaxed by using multinomial probit or nested logit specifications. Second, the model does not explicitly incorporate prices or price formation. Once prices are explicitly built into the model, the model can be used to examine the environmental impact of changes in agricultural, trade, or macroeconomic policies through their effect on output and input prices. Finally, the spatial framework presented here can be used to consider a broader class of environmental impacts, such as pollution from agricultural runoff.

We stress that this article is only a sketch of an analytic strategy. A thorough analysis would involve calculation of the impacts of particular road-siting alternatives. It would also allow for general equilibrium effects: a substantial increase in cropped area would boost wages and reduce the prices of domestically consumed agricultural products, changing the coefficients embodied in the model. Finally, it would take into account distributional effects (across income groups or regions) of altered cultivation patterns.

Our methodology also has applications to conservation planning, because there is a need for techniques that predict threats to protected areas. The tools presented here emphasize the use of soil maps for assessing the spatial patterns of threat, and also help to predict the nature of that threat—information that could be useful in designing integrated development and conservation programs.

These techniques can also be used to gauge the effectiveness of habitat protection. In Belize we observe very little cultivation in national parks and private reserves (about 0.5 percent). Is this because these areas are effectively policed, or is it because they are remote or otherwise unattractive for cultivation? To address this question, we use the estimated coefficients to predict the extent of cultivation to which these areas would be subject if they were not protected. Taking the expectation of predicted probabilities, we estimated that 5 percent of the national park area in southern Belize would be under current cultivation, suggesting that habitat protection has been effective in Belize.

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Industrial Centralization in Indonesia

J. Vernon Henderson and Ari Kuncoro

In certain situations, economic liberalization policies can increase the degree of spatial centralization of resources and spatial concentration of manufacturing in large metropolitan areas. In addition, historical patterns of location make it difficult to alter the degree of centralization. This article explores these issues by specifying and estimating a nested logit model of industrial location of manufacturing activity in Java, focusing on the unincorporated sector. The results indicate that plants strongly prefer locations with mature plants in related industries, which offer a built-up stock of local knowledge. In addition, the 1983 liberalization in Indonesia was associated with increased centralization of the unincorporated sector. Although the liberalization gave unincorporated firms better access to government and other centralized services, firms needed to centralize to take advantage of these opportunities because the bureaucratic process is centralized and communications are poor. The relative increased growth of the corporate sector following liberalization may also have helped to further draw unincorporated plants into centralized locations.

Spatial centralization of resources and spatial concentration of manufacturing in a country's largest metropolitan areas are issues that many developing countries have been struggling with for two or more decades (see, for example, Renaud 1979, Hamer 1983, and United Nations 1993). The types of concerns represented in United Nations (1993) are widespread and representative. This report asks how bad "the negative factors associated with very large cities" need to get "before [it is in the] self-interest of those in control to encourage development of alternative centers." The same report warns of "unbalanced urban hierarchies" and congestion, crime, and social inequality in very large metro areas.

Although we do not necessarily subscribe to this view, it gives a motivating context for this article. We focus on two issues. First, in certain situations will economic liberalization policies work to increase significantly the degree of centralization and concentration? Second, for countries seeking to lower the degree of centralization, do historical patterns of location strongly and directly influence current patterns, making it more difficult to alter the degree of centralization?

We examine these issues in the context of Indonesia, focusing on Java. Although the results are specific to Java, we believe the analysis is quite general, as are the implications of the results. The conditions in Indonesia affecting spatial centralization are not atypical. The switch in regimes which occurred in Indonesia in the early 1980s consisted of common liberalization policies. Under similar circumstances in other countries, we might expect similar responses to economic liberalization policies of similar construct. In addition, we expect the influence of historical patterns of location on current patterns in Indonesia to operate in the same fashion in other countries (see, for example, work on the United States in Henderson, Kuncoro, and Turner 1995).

Section I provides a contextual background on the manufacturing sector in Indonesia. It outlines the degree of centralization of resources in Indonesia and institutional aspects of the manufacturing sector. Section II discusses the factors affecting location choices and decentralization in the manufacturing sector in Java. Section III describes the data used in the analysis. Section IV specifies and estimates a model of industrial location of manufacturing activity in Java and identifies the most important issues affecting decentralization. Section V examines how the historical environment of a locality affects current location decisions. Section VI examines the effects of economic liberalization on centralization of industry. Section VII presents conclusions.

I. THE MANUFACTURING SECTOR IN INDONESIA

In Indonesia between 1980 and 1990 the ten largest urban areas (those with more than 1 million people) grew at an average annual rate of 5.3 percent, led by Greater Jakarta at 5.9 percent. In contrast, the next 15 metro areas (those with populations of more than 200,000 but less than 1 million) grew at an average annual rate of 3.9 percent (World Bank 1993). Thus urban concentration increased in Indonesia, a situation that international agencies view as a problem (for example, World Bank 1989).

Indonesia's main island of Java contained 61 percent of the national population and 78 percent of adult full-time workers employed nationally in manufacturing in 1985. Java's population of more than 110 million lives on an island the size of Arkansas in the United States. On the positive side, between 1980 and 1985 population growth (12 to 13 percent) and manufacturing employment growth (26 percent) were the same for Java as for Indonesia as a whole. However, between 1980 and 1985 in Java the concentration of population and centralization of manufacturing increased. In the four main metro areas (Greater Jakarta, Bandung, Surabaya, and Semarang), population increased by 32 percent, and manufacturing employment increased by 51 percent.

There are three major categories of manufacturing firms in the Indonesian Census: government firms (*perum*), the equivalent of incorporated firms (PT/NV), and unincorporated firms (*perorangan*). In this study, we focus on the location decisions of firms in the private sector. The incorporated sector ac-

counts for 55 percent of nonfood manufacturing employment, and the unincorporated sector accounts for 34 percent. The unincorporated sector contains smaller plants, which tend to be less tied to government policy decisions, such as decisions affecting the financing of business activity by state banks or the granting of export and import licenses. In the unincorporated sector we include all plants that operate with a permit. Home producers (without a permit) and a small group of tiny firms operating illegally (without a permit) are excluded. Basically, the unincorporated sector covers virtually all private manufacturing activity that has a separate place of business (and is unincorporated). We break down firms in the unincorporated sector into notarized proprietorships and non-notarized firms. Notarization conforms to European concepts and indicates a more formal business place, whose proprietors have more secure titles to their assets. Non-notarized firms tend to be smaller and more informal.

The Location of Firms in Java

Table 1 reveals the radical difference in the locational patterns of the incorporated and unincorporated firms in Java. Although table 1 reports employment figures, the relative figures for the number of plants are almost identical. With great consistency across the two-digit sub-components of manufacturing, 86 percent of corporate employees work in plants in a *kabupaten* (a district or county) whose center is within 50 kilometers of the center of one of the four major metro areas in Java. In contrast, and again with considerable consistency,

Table 1. *Percentage of Nonfood Manufacturing Employees Working in Centralized Plants, Java, 1985*

| Industry | All plants | Corporate sector | Unincorporated sector | | Government sector |
			Notarized	Non-notarized	
Textiles	71	85	59	57	37
Furniture and wood products	50	87	43	30	46
Printing, publication, and paper	76	80	63	61	75
Chemicals	76	79	72	61	61
Nonmetallic minerals	65	91	35	32	66
Machinery	84	94	63	40	86
Miscellaneous manufacturers	60	86	46	48	75
Total nonfood manufacturers	69	86	56	44	59
Average firm size (number of employees)	—	208	40	8	271

— Not calculated.

Note: Centralized plants are those located within 50 kilometers of one of the four major metro areas in Java.

Source: Authors' calculations.

only 49 percent of employees in the unincorporated private sector work in plants within 50 kilometers of one of the four major metro areas. Within the unincorporated sector, centralization is higher (56 percent) for the larger notarized firms than for the non-notarized firms (44 percent) and is higher for some industries (chemicals and machinery); but, overall, the unincorporated sector remains much more decentralized than the incorporated sector.

What explains these differences in the location of plants for incorporated firms compared with that of unincorporated firms? It is not simply plant size differences or differences in the extent of government ownership. Within any category, plants nearer metro areas tend to be somewhat larger. If we control for plant size, however, the locational differences remain. For plants with 50 to 100 employees, for example, 88 percent of corporate sector employees and only 61 percent of the notarized unincorporated firms are in the 50-kilometer radius. Government participation in ownership does not explain the difference; virtually all workers in the unincorporated sector work in plants that are 100 percent privately owned. In the private corporate sector, 22 percent of employees work in plants where government participates in ownership. About 90 percent of employees in those plants work within the 50-kilometer radius, compared with 85 percent of employees in corporate plants that are entirely private.

An important difference between incorporated and unincorporated firms affecting location patterns is that the corporate sector is much more export oriented. Because Java has relatively poor interregional freight transportation and containerization development, export-oriented firms have a strong incentive to locate in big coastal ports, rather than in lower-cost, medium-size cities, even for very standardized manufacturing products. By contrast, in industrial countries, standardized manufacturing tends to locate in small and medium-size cities because land rents in medium-size cities are a fraction of those in metro areas and wage costs for skilled workers can be half or less than those in metro areas. But for big corporate firms to locate plants in hinterland cities, there must be good interplant communications and good transport to major export points, both of which are generally lacking in Java. Thus, the export-oriented corporate sector finds more centralized locations necessary. It is interesting to observe that in Java, recent major transport developments tend to be followed by massive relocation of corporate plants. For example, the government has extended toll roads from Jakarta east and west into the nearby Great Jakarta region (Botabek and beyond). Rapid and massive relocation and growth of corporate plants along the toll roads have occurred, as industry has moved out of the Jakarta urban area (DKI Jakarta) to the outskirts to take advantage of lower land costs and wages. Now over 75 percent of new corporate plants in the Jakarta region are established outside the main urban area (see Henderson, Kuncoro, and Nasution forthcoming).

Another feature that contributes to the centralization of corporate plants is the operations of the government and capital markets. Government in Indonesia is unusually centralized (World Bank 1989, 1993), including centralization

of regulation and licensing procedures of large (corporate) export-oriented plants. The banking system is also highly centralized. In the period from 1980 to 1985, Indonesian banking was dominated by state-owned banks that operated in a strict hierarchy of limits on loan sizes and categories, with smaller branches and branches in more remote locations having the strictest limits. Although an administrative hierarchy is not unusual in other countries, in Indonesia all applications for loans of a significant size must be pursued in Jakarta and can be approved only by the board of directors of the banks.[1] Basically, the system operates so that politically and socially connected applicants have the best chance of success at the lowest overall effective cost. Access to capital markets is thus much better for large centrally located firms. While such firms could keep that access and decentralize some production, poor intercity transport and communications make that difficult. Traditionally, unincorporated plants had little access to capital markets. In our data, for example, in one category of plant size (50 to 100 employees) the average loan size for capital expansion for corporate firms is 191 times that for unincorporated firms.[2] Of course, because part of the reason to incorporate is to better qualify for loans, this comparison of averages suffers from severe selection bias. But the biggest adverse impact of the strict banking hierarchy is likely to be on the single-plant unincorporated sector.

Decentralization of Private Unincorporated Firms in Java

Given the high and ongoing centralization of corporate firms within the overall context of Java, not much can be learned from studying their degree of decentralization. Later, we briefly present and review some results for the corporate sector from the appendix. Here we focus on how history and episodes of liberalization have affected decentralization of the private unincorporated manufacturing sector.

Can economic liberalization policies encourage centralization of resources? Indonesia presents an ideal place to pose this question. Starting in mid-1983, Indonesia undertook a variety of liberalization measures, including modest reform of export licensing procedures. The most dramatic reforms were in the banking sector. Public sector loans were made "competitively available" at market interest rates (Harris, Schiantarelli, and Siregar 1994), instead of being rationed and subsidized. In addition, restrictions on the private part of the banking industry were lifted, permitting rapid growth in this sector. Liberalization potentially opened capital markets to smaller, less well-connected firms in the unincorporated sector. However, liberalization may not have helped decentralization. Liberalization did not remove the administrative and spatial hierarchy in the loan process or the interpersonal nature of granting larger loans. To take advantage

1. Even in August 1994 the loan limit for the major government bank, Bank Rakyat Indonesia (BRI), was $0.5 million; applications for higher amounts had to be pursued centrally with the Board of Directors of BRI.

2. However, the sample size in our data is small—fourteen plants in each of the incorporated and unincorporated sectors getting loans, in that plant size category.

of liberalization in terms of obtaining significant size loans for capital expansion (beyond lines of credit), unincorporated firms would need to pursue loan applications and personal contracts in a few large metro areas. It seems that for a single firm effective access to large loans in the capital market would be greatly enhanced by centralized location.

In Java in 1983, there was a dramatic shift in the location patterns for all two-digit, nonfood, unincorporated manufacturing firms. This shift corresponds both to the date of the general announcement of Indonesia's liberalization and to some specific implementations in the financial markets. Data for aggregate employment in new plants in nonfood manufacturing are given in table 2. For the corporate sector there is some fluctuation but little overall shift from 1980 to 1985; on average, about 88 percent of employees in new plants located within the 50-kilometer radius of the four major metro areas during that period. For notarized firms in the unincorporated sector, about 52 percent of employees in new firms located in the 50-kilometer radius from 1980 to 1982 and 64 percent from 1983 to 1985. The jump is right at 1983, the year of the liberalization. For non-notarized firms, given their smaller size and inferred lower access to any credit market, the shift to more centralized new firms occurs a little more gradually. But again centralization increased sharply from an average of 43 percent of employees in new firms from 1980 to 1982 to 57 percent from 1984 to 1985. We infer that liberalization was responsible for the increase in centralization in the unincorporated sector. As with any regime switch, it is impossible to prove this causality. Later, nevertheless, we will further detail why we think the increased centralization was associated with liberalization.

We also note that the numbers for the unincorporated sector understate the overall shift in centralization. Between 1980–82 and 1984–85, the annual number of new firms increased by about 60 percent in the corporate sector and by only 35 percent in the unincorporated sector. Because more new firms in the corporate sector are centralized, the extent of overall increased centralization is understated by analysis based on new firms in the unincorporated sector.

Table 2. *Percentage of Nonfood Manufacturing Employees Working in Centralized Plants for Different Age New Plants, Java, 1980–85*

Year of establishment of plant	Corporate sector	Unincorporated sector	
		Notarized	Non-notarized
1980	94	48	42
1981	75	56	42
1982	94	52	45
1983	91	64	48
1984	91	64	55
1985	87	63	58

Note: Centralized plants are those located within 50 kilometers of one of the four major metro areas in Java.

Source: Authors' calculations.

Firms have responded to major decentralization efforts, such as widespread regional development of transport and communication facilities. The response to major infrastructure development in more distant hinterlands often seems slow, however. Evidence from other countries suggests that past patterns of industrial location tend to guide present patterns (see Hamer 1983 on Brazil and Lee 1989 on Korea). Plants in a particular industry tend to go to locations where there are already high levels of own-industry employment; own-industry employment is mature, or has been there for some time; and the existing industrial base is diverse. The literature suggests that history directly influences location, which is based partially on externalities, particularly dynamic externalities (Glaeser and others 1991; Henderson, Kuncoro, and Turner 1995). Dynamic externalities suggest a process of local knowledge accumulation (based on both local spillovers among firms and individual investments in knowledge), where today's local stock of knowledge (local trade secrets) about technology and about input and output market features and conditions depends on past levels of local own-industry activity. Altering current patterns of industrial location partly involves overcoming these conditions from the past, so that informationally deficit locations can compete with traditional locations for new plants. In Indonesia the problem may be heightened by the almost complete centralization of the corporate sector, which could draw in and hold unincorporated plants in central locations because of the positive externalities offered by the corporate sector. Although it may be easy for centralization to increase (for example, because of liberalization), the move toward decentralization to nontraditional locations may be harder.

II. Factors Affecting Location Choices and Decentralization

We divide the factors affecting the locational choice of nonfood manufacturing firms in Java into four categories, although the division for some variables is arguable. The categories are market conditions, the historical-industrial environment, infrastructure, and distance. We describe the conditions in 1980, which were those that new plants about to enter the market from 1980 to 1985 faced.

Market Variables

Local wage rates measure cost differences across *kabupaten* in hiring labor. For plants the relevant variable is the nominal wage rate because that is what they pay and what affects firm profits. For similar real wages across locations (nominal wages deflated by local costs of living), nominal wages vary by a factor of two or three in developing countries (see Henderson 1988) and by even a twofold factor in industrial countries. To measure the industry wage rate, we use total annual compensation divided by total paid employees in all firms existing prior to 1980 outside the industry. This represents a measure of the going manufacturing wage rate. It may be sensitive to local industrial composition, but we control for that in other variables (see next subsection).

The *kabupaten* population measures local demand for unincorporated firms. It affects the price at which these firms can sell their product and the proportion that can be sold locally without incurring significant transport costs. An alternative demand control would be *kabupaten* gross product, if available; but, relative to population, the gross product would be subject to great measurement error. Population is sometimes also used to reflect availability of certain market services and government services, but these phenomena will be represented by other variables here.

Industrial Environment

Each location offers potential plants a stock of local knowledge and a commercial environment of business services, suppliers, and buyers. The commercial environment can also be thought of as a stock variable established over time through accumulated location decisions made by public and private entities. Each location has a local body of knowledge about technology (Romer 1986), local adaptations of technology, potential suppliers and buyers, and location-specific aspects of the functioning of the bureaucracy (how to facilitate a license application in a particular *kabupaten*). Such knowledge is built up over time and represents a stock of local trade secrets about how to adapt technologies and operate in local markets. Knowledge appears in other studies to be highly localized and to diffuse slowly over space (Jaffe, Trajtenberg, and Henderson 1993). Empirical work suggests the presence of both static (see Henderson 1988 for a review) and dynamic externalities (for example, Glaeser and others 1991 and Henderson, Kuncoro, and Turner 1995). Although we cannot measure local knowledge, we can identify its likely determinants.

For a particular industry, information comes in part from other local plants in the industry; therefore the local industrial environment will be characterized first by the stock level of own-industry activity in that *kabupaten*. That is measured by 1980 employment in that industry as measured in the 1980 Population Census. The notion that plants in the same industry locally learn from each other and contribute to a common local knowledge base also explains why plants in the same industry cluster together spatially. So, typically, an industry has local specialization, whereby some locations have few or no plants and others have large clusters that enjoy positive externalities. However, plants also learn from other industries, such as other manufacturers. In fact, Jacobs (1969) argues that local diversity of economic activity is important for industry development—diversity encourages exploration and prevents stagnation by exposing local producers to a variety of techniques and ideas from outside their own industry. Thus, diversity of other manufacturers contributes to knowledge and could also provide Dixit-Stiglitz (1977) local-scale benefits from diversity and availability of intermediate inputs.

We measure local diversity (or, actually, lack of diversity) by the standard Hirschman-Herfindahl Index (HHI), equal to the sum of squared shares of employment by two-digit manufacturing industry in all other local manufacturing

employment. For any industry there are eight other manufacturing industries. If all other manufacturing employment is divided equally across two-digit categories, the HHI takes a minimum value of 0.125, indicating no concentration, or perfect diversity. As HHI rises, so does concentration, or diversity falls. HHI takes a maximum value of 1.0 when all other manufacturing employment is concentrated in just one two-digit component.

The maturity of the manufacturing environment may also matter, especially with a dynamic externality interpretation. Existing complementary (and even competing) plants that have a long experience may represent an advantage to new locators, relative to a situation where existing establishments are also inexperienced. Mature plants are better informed about persistent local supply conditions, local demand conditions, and the local institutional environment. New firms benefit by observing, to the extent feasible, how established firms operate in the local environment and deal with problems. Maturity of the environment is measured by an employment-weighted average of the age of all old manufacturing plants outside the own industry in the *kabupaten*, divided by the national average for each industry.

The measures of the local industrial environment detailed so far relate to aspects of manufacturing. A remaining key aspect of a local environment is the availability of business and government services. To capture that, we use diversity in one-digit activity. This variable is closely related to the extent of urbanization of the *kabupaten*. Variation in this one-digit diversity measure comes from swings in the extent of agriculture, with offsetting swings in services and commercial activity. Thus the one-digit diversity measure represents the extent to which an area is urbanized and offers business and government services, compared with a rural area that is deficient in services. For each of our two-digit manufacturing industries, when we calculate an HHI of all one-digit employment, we subtract the own- (two-digit) industry employment from the manufacturing and total employment measures in the index.

Infrastructure

Infrastructure as represented at the level of a *kabupaten* proved elusive to measure. In our data, *kabupaten* measures—such as length or percentage of all roads that are paved, percentage of houses served by telephone, and percentage of villages with phone service—are almost perfectly collinear with the percent of the population that is urbanized. The percentage of the population that is urbanized in turn is strongly correlated with the HHI for all one-digit economic activity. A high HHI represents an agricultural area; as HHI declines, services, retailing, and manufacturing increase relatively. We could not sort out these different effects, so we used the HHI for all economic activity to represent the extent of local development of general services (and urbanization) of the economy.

However, for electricity we have a measure that is not so collinear with indexes of urbanization: a measure of reliability of state Perusahaan Listrik Negara (PLN) service. First we note that oil is the energy choice in Indonesia when

technologies permit petroleum (internal combustion) power. Plants use electricity for lighting and for technologies that are usually driven only by electric motor. PLN service is widely available, but hook-ups and consistency are problems. Where service is poor, plants requiring electricity need a backup source. While electricity can be privately bought and sold, the data on consumption indicate most plants provide their own backup by installing their own generators. As an index of *kabupaten* reliability and availability of state service, we use the percent of existing plants in the *kabupaten* with a generator. There is considerable spatial variation in the consumption of plant-generated electricity (compared with PLN service) and in the reliance on and existence of generators. Traditionally, the more existing plants there are with generators, the less reliable the PLN service.

Distance

Distance is measured in 50-kilometer units of the straight-line distance from the center of a *kabupaten* to the center of the nearest of the four metro areas in Java. Although, generally, distance captures the transport costs of selling in the nearest national market center, here it has a more critical aspect. Distance, as well as possibly low population, may represent lack of access to the centralized banking system, to the centralized granting of export and import licenses, and to the centralized bureaucracy.

III. THE DATA

In considering the spatial allocation of resources in Java, we examine the location patterns of new nonfood manufacturing plants from 1980 to 1985, with liberalization occurring in mid-1983. We do not include food processing because it is based on the plantation system and regional peculiarities of food production (Hill 1987), which would deserve a separate study. We compare three years of data prior to liberalization (1980–82) with two years afterwards (1984–85). Although two complete years are not a long enough period for all basic responses to work themselves out, we can look for indications of a significant episodic shift in economic behavior after 1983.

Data on plants are taken from the plant-level data tapes for the 1986 Economic Census covering small, medium, and large plants, but not household production. Our sample includes all firms classified as private unincorporated— both notarized and non-notarized. Flows, or new plants, are defined as plants that started business between 1980 and 1985. Old plants are those still existing in 1985 that started business before 1980. Plants are classified at a two-digit level as defined in table 3, along with the major three-digit subcomponents for each two-digit industry. We also use the 1986 Economic Census to calculate wages, average age of old plants, and electrical generating capacity.

Data from the 1980 Population Census provide baseline (1980) characteristics such as *kabupaten* population, employment in different one-digit industries,

Table 3. *Industry Definitions and Coverage*

Two-digit category	Some three-digit components	Share of three-digit component in two-digit category (percent)
Textiles[a]	Textiles	68
	Apparel	25
Wood and furniture	Wood products	55
	Furniture (most wood)	45
Publishing and paper	Paper	33
	Printing and publishing	67
Nonmetallic minerals	Clay	14
	Cement	81
Machinery	Primary metals[b]	6
	Fabricated metals	35
	Machinery	9
	Electrical machinery	21
	Transport equipment	28
	Scientific instruments	1
Miscellaneous[c]	Sporting goods	16
	Toys, jewelry, and musical instruments	8
	Office equipment	13
	Other	64

Note: Indonesia divides manufacturing into nine two-digit categories. These two-digit categories are further subdivided into three-digit subcategories. We list the shares of major three-digit industries in the respective two-digit parent category.

   a. Footwear and leather products are excluded from this analysis.
   b. This is a small separate two-digit industry.
   c. These subcategories represent aggregations of lower-digit activity.

Source: Authors' calculations.

and employment in two-digit manufacturing plants. Data from the 1980 PODES (Survey of Villages) measure geography (altitude, distance to coast, area) and phone service and roads in the *kabupaten*. We use price data from the 1984 SUSENAS (National Economic Survey on Household Expenditures) for instrumental variables.

We study industries in textiles, wood and furniture products, publishing and paper, nonmetallic minerals, machinery, and miscellaneous products. We exclude food processing and chemicals because the former is dominated by plantation activity, which is not our focus here, and the latter is dominated by the petroleum and rubber industries, which are under government or foreign control (Hill 1990). Our basic results on decentralization hold for chemicals also (Kuncoro 1994). This industry is just less sensitive to local market conditions than the other more free-market sectors.

IV. A MODEL OF INDUSTRIAL LOCATION

In this section we present a model of locational choices by unincorporated firms for new manufacturing plants in Java. Unincorporated firms are unconstrained in locational choices, in the sense that, unlike the corporate sector, they have no noticeable government participation (partial ownership, representation on boards of directors) and have little or no foreign or overseas Chinese participation in ownership. We study decisions for new plants—the flows—as opposed to the historical decisions of the stock of plants. Estimates from this model will help us understand decentralization issues by quantifying the role of infrastructure investments, urban agglomeration, access to major metro areas, and history—the built-up and established industrial environment. These estimates in turn will allow us to start to assess the effect of regular industrial decentralization policies and of regime switches such as liberalization.

Locations are *kabupatens,* or roughly districts-counties, of which Java has 106. The *kabupaten* is a basic political unit from which allocations of infrastructure are made. Only a few metro areas are defined, beyond the area of a *kabupaten,* so doing a geographic division into cities is not feasible. However, our locational attributes will capture the level of urban sophistication of the *kabupaten.*

We focus on entrepreneurs' discrete choice of *kabupaten* in which to locate their plants. This choice is nested in entrepreneurs' discrete choice of industry. We need a framework that allows for discrete choices and also for different types of discrete decisions. A natural choice, which is computationally feasible, is the nested logit model. "First" entrepreneurs choose a two-digit manufacturing industry, and "then" they choose a geographic area for their plants. Because more than one plant from an industry may locate in a *kabupaten,* it is also possible to have a third level of nesting to test whether error drawings of plants in the same industry and geographic area are correlated. The whole model is specified and estimated in Kuncoro (1994). Here, although we discuss analysis of the other levels of the hierarchy, we focus on the middle level, looking at locational choices of plants by industry (that is, conditional on the industry chosen). Using these results, we then analyze the decentralization issues and further estimate the impact of regime switches such as liberalization.

The Econometric Specification

For the plant choice of location, the framework is related to standard work in Carlton (1983) and Lee (1989). Within an industry, plant j chooses location k from among M possible locations, if

$$(1) \qquad \Pi_{jk}^{*} = \max[\Pi_{j1}, \Pi_{j2}, \ldots \Pi_{jM}] \quad j = 1, \ldots N$$

where Π_{jk} is the log of long-run profits associated with location k for plant j. In turn

$$(2) \qquad \Pi_{jk} = \beta X_k + \varepsilon_{jk}$$

where X_k are locational attributes in linear, log, or dummy variable form at location k and ε_{jk} is an error drawing. Thus, plant j chooses location k if

(3) $\beta X_k + \varepsilon_{jk} \geq \beta X_\ell + \varepsilon_{j\ell}$ for all $\ell \neq k$.

If the error terms are independent and identically distributed (iid) and distributed extreme value, then the probability P_{jk} that plant j locates in k is given by the conditional logit model where

(4)
$$P_{jk} = \frac{\exp(\beta X_k)}{\displaystyle\sum_{s=1}^{M} \exp(\beta X_s)}$$

In estimation, parameters of the model are only identified by imposing a normalization that the constant term be zero.

The iid assumption for error terms requires that plants choosing the same location do not have correlated errors in a nested logit setting, using the generalized extreme value distribution. Kuncoro (1994) tests for this and rejects the hypothesis of correlation for four of our six industries. But even for the other two, the correlation is very small.[3] The suggestion is that generally the X_k variables fully measure the relevant overall (or common) *kabupaten* characteristics facing firms choosing locations. The ε_{jk} can still measure site or neighborhood-village characteristics specific to the different intra-*kabupaten* sites that firms choose, where these are iid drawings.

In addition to the locational choice model, equation 3 has an upper level of nesting, where firms choose an industry on the basis of average profits for existing plants within the different industries, the standard deviation of profits across existing plants within an industry, and an inclusive value from the locational-choice nesting level. Kuncoro (1994) finds significant positive and negative coefficients, respectively, for the mean and standard deviation of profits, and an inclusive-value coefficient of 0.075 (the corrected standard error is 0.0023), suggesting a high level of correlation for a firm in the error drawings it faces across locations, given its industry of choice. Combining the upper- and lower-level nesting results, the implication is that error drawings are more related to specific unmeasured characteristics of the firm or entrepreneur (rather than overall *kabupaten* characteristics).

Given this background, we focus on locational choice for firms in different industries, conditional on industry choice. The implication is that these factors will also affect industry choices, as a second order magnitude.

3. With no plant-specific characteristics, the lower level nesting collapses to an inclusive value for our level of estimation of log N_k, where N_k is the number of firms choosing location k in the industry. In estimating equation 3, the coefficient on log N_k equals $1 - \rho$, where ρ is virtually the correlation coefficient for the plant error drawings within a *kabupaten*. For textiles, miscellaneous wood and furniture, and nonmetallic minerals, we cannot reject the hypothesis that $1 - \rho = 1$. For machinery and paper, $1 - \rho$ equals 0.91 and 0.88, respectively, with (corrected) standard errors of 0.029 and 0.045, respectively.

Estimation Issues

In constructing our variables explaining industrial location, to try to minimize potential endogeneity, we were careful to exclude own-industry and new-plant components for all measures. However, the results of the Smith and Blundell (1986) test for endogeneity of right-hand-side variables strongly suggested that, for all variables (except distance), endogeneity remains a critical problem (Kuncoro 1994).[4] Accordingly, we constructed a set of instrumental variables to use in the first stage of two-stage estimation of the logit model, so right-hand-side variables in logit estimation (except for distance) are predicted values from first-stage ordinary least squares equations. The idea is to use as instrumental variables in the first stage only truly exogenous measures (access to market centers, geographic area, distance to the coast, altitude, annual rainfall) or measures of prices and quantities from outside the own *kabupaten*, which are exogenous to the own *kabupaten*.

Quantities and prices in the own *kabupaten* are determined in a general equilibrium context, as influenced by the government's allocation across *kabupatens* of infrastructure, by nature's allocation of natural resources, and by contemporaneous error drawings. If prices or quantities are higher in other *kabupatens*, that affects the market and in particular government allocation of resources to the own *kabupaten*. For example, a *kabupaten* is more likely to have better roads if it is surrounded by more populous *kabupatens*. Given government allocation rules, the most influential *kabupatens* are contiguous to the own *kabupaten*. For instruments, we use the average for contiguous *kabupatens* of ten food price indexes (see Kuncoro 1994 for calculations) and wages. We also average quantities for contiguous *kabupatens* of altitude, coastal access, area, number of manufacturing households, population, and percentage of population that is urban and percentage with high school education. These variables give a reasonably high level of explanatory power to first-stage regressions for all right-hand-side variables. First-stage R^2s are all above 0.5 (most are in the 0.75–0.9 range) except for the maturity index for textiles, wood products, and paper; for HHI in manufacturing for wood products; and for wages and past employment in nonmetallic minerals. The lowest of these is 0.16 (maturity in paper) and the next lowest is 0.33.

Because of the two-stage estimation process, standard error estimates in the second stage (which uses predicted values of right-hand-side variables) are biased. Unbiased estimates are obtained by following the standard procedure (Murphy and Topel 1985) to fit our problem with seven endogenous right-hand-side variables in the logit equation for each industry. The calculations are given

4. This contrasts but does not necessarily conflict with the notion that the error terms for plants within a *kabupaten* are iid. The contemporaneous error terms for individual plants can each affect the right-hand-side variables but still be independent both in theory and conceptually. Conceptually, the ε_{jk} may reflect specific village-neighborhood conditions of the specific different sites where plants locate in the *kabupaten*. These can be iid; but these differing village conditions themselves influence overall *kabupaten* characteristics.

in Kuncoro (1994) and follow those in Pitt and Rosenzweig (1990). Although the computations are straightforward in concept, implementation in a problem of this size is extremely time consuming. The standard errors in table 4 are appropriately corrected, with an indication of the effect of the correction. The one-digit industry diversity measure for all economic activity is the most adversely affected. Results later in the article, showing the effect of experimentations to estimate the impact of regime switches or application to the corporate sector, have uncorrected standard errors.

Overview of the Results

The basic results for textiles, wood and furniture products, nonmetallic minerals, machinery, publishing and paper, and miscellaneous manufacturing are given in table 4. Here we analyze briefly the econometric results before turning to the interpretation of results as they relate to decentralization issues. Coefficients in table 4 are parameters of a normalized profit function (with a zero constant term). Profits are not the dependent variable per se, since the dependent variable is the discrete choice of *kabupaten* in which to locate. From these choices, given the functional forms specified, we infer the parameters of the profit function.

Coefficients of variables generally have the anticipated effects. Also, the impact of the two-stage work is generally as anticipated from related work (for example, Henderson 1988). In particular, wage variables are strengthened (coefficients switch from positive to negative), and so is the maturity index (negative coefficients switch to positive in isolating the age effect from competitive decentralization—new firms choosing new locations). Other variables that are sometimes "improved" in the direction of anticipated effects include past own-industry employment, HHI for manufacturing, and distance. The HHI for all industries is generally weakened (see Kuncoro 1994 for details).

MARKET AND INFRASTRUCTURE VARIABLES. Wages have a negative coefficient for five of the six industries and the population coefficients are always positive. Not surprisingly, coefficients on population (our local demand measure) are highest for products containing a large component of goods that are dependent on local markets and less traded across *kabupatens*—publishing (local print shops), textiles (apparel or tailored products), and nonmetallic minerals (building materials and clay pots). For the one reported infrastructure variable, the percentage of existing firms in 1980 with a generator, three of our six industries have a strong negative coefficient. The textile industry is of particular interest because it is so heavily dependent on electricity.

How do we interpret the coefficients in table 4? Since the estimates are normalized by setting the constant term in the profit function to zero, it is somewhat questionable to give a direct profit function interpretation to the coefficients. With such an interpretation for the variables in logarithms in table 4, the coefficients are elasticities of the profit function itself. Wage elasticities for sta-

Table 4. *Industrial Location for the Unincorporated Sector, Java, 1980–85*

Variable	Textiles	Furniture and wood products	Nonmetallic minerals	Machinery	Publishing and paper	Miscellaneous
Wages	−1.89	−0.381	0.088	−0.737	−0.071	−1.12
	(−3.96)	(−14.12)	(0.649)	(0.530)[a]	(−1.24)	(−1.92)
ln population	0.984	0.494	0.711	0.283	1.64	0.099
	(5.98)	(0.693)[a]	(3.48)	(1.83)[a]	(4.58)[a]	(0.165)
ln 1980 own-industry employment	0.368	0.246	0.265	0.129	0.0001	0.196
	(7.59)	(1.16)[a]	(26.24)	(19.25)	(0.576)	(5.82)[a]
HHI: manufacturing[b]	−2.97	−0.692	−1.44	−1.21	−0.314	−2.37
	(−1.75)[a]	(−0.509)[a]	(−28.31)	(−9.97)	(−6.52)[a]	(−30.48)
Maturity index: manufacturing[c]	0.441	0.952	0.705	0.444	0.431	0.477
	(4.93)	(8.04)	(33.25)	(0.847)	(0.018)[a]	(2.27)
HHI: all industries[b]	−6.25	−2.39	1.13	−2.75	−2.32	−6.51
	(−1.79)[a]	(−1.04)[a]	(0.903)[a]	(−0.266)[a]	(−1.66)	(−0.607)[a]
Percentage of existing plants with a generator[d]	−0.028	−0.009	−0.013	0.015	0.006	−0.007
	(−2.63)	(−0.824)[a]	(−7.19)	(0.507)	(0.169)	(−17.92)[a]
Distance[e]	−0.532	−0.333	−0.150	−0.482	−1.31	−0.584
	(−9.26)	(−0.270)[a]	(−12.48)	(−10.48)	(−22.79)	(−14.59)
Number of observations	4,857	3,574	4,297	1,460	756	693

Note: Coefficients are from logit estimation in which the dependent variable is the discrete choice of *kabupaten* in which to locate. *t*-statistics based on corrected standard errors are in parentheses. The correction has a consistent impact on the HHI indices, tending to reduce their significance level, especially for HHI: all industries.

a. Indicates a coefficient that switches from being significant to insignificant or vice versa, following standard error corrections, due to two-stage estimation.

b. The Hirschman-Herfindahl index (HHI) for manufacturing is a measure of diversity of manufacturers; it is the sum of squared shares of employment by two-digit manufacturing industry in all other manufacturing. The HHI for all industries measures local economic diversity. It is the sum of squared shares of one-digit employment in all employment.

c. Maturity of the manufacturing environment is measured by an employment-weighted average of the age of all old manufacturing plants outside the own industry in the *kabupaten*, divided by the national average for each industry.

d. Existing plants are those in existence in 1985 that were established before 1980.

e. Distance is measured as the straight-line distance from the center of a *kabupaten* to the center of the nearest of the four metro areas in Java.

Source: Authors' calculations.

tistically strong coefficients range from −0.4 to −1.9, and population elasticities range from 0.3 to 1.6. These do seem like reasonable magnitudes. Below, in table 5, we will give an alternative interpretation of coefficients based on percentage effects on location probabilities.

INDUSTRIAL ENVIRONMENT. Past own-industry employment always has positive coefficients in table 4, indicating the positive effect of historical own-industry activity. It is statistically weakest for publishing and for furniture, corresponding to results in Henderson (1988), where these industries in the United States and Brazil are less affected by local own-industry scale. Other aspects of the industrial environment also conform to expected outcomes. The diversity of the surrounding manufacturing environment has a strong impact, where an increase in HHI for manufacturing, which is a *decrease* in diversity, always has a negative sign. Again, these effects are weakest for publishing and furniture. The maturity of the manufacturing environment also matters; more mature environments are better, in all industries. However, diversity of the general economic environment, which controls for urbanization and economic sophistication of the *kabupaten*, has no statistically significant effect, once standard errors are corrected. It does have expected negative signs with large coefficients in five of the six industries, with fairly high *t*-statistics for some industries.

DISTANCE. In all cases except furniture, distance has a strong negative significant coefficient, indicating a drop-off in the probability of a *kabupaten* attracting plants in the industry as the location moves away from major metro areas, controlling for all other *kabupaten* characteristics. This is an unusual result. For example, work on Brazil (Henderson 1988), where much longer distances are involved, as well as on the United States (Henderson, Kuncoro, and Turner 1995), finds little or no effect of access to major national metro areas or regional capitals, *once the analysis controls for* other effects (such as population and diversity). That is, for unincorporated plants whose markets are fairly local, we would expect, after controlling for *kabupaten* characteristics, that access to a major metro area is not very important. The proportion of plants locating in a *kabupaten* would be driven by demand characteristics in that area relative to other areas. But for Indonesia, access to major metro areas is a major determinant of where even unincorporated firms locate. This suggests that to function—get parts, materials, permits, financing—unincorporated firms are drawn out of local markets toward major metro areas. To overcome that draw would require some combination of transport and communication infrastructure development and perhaps institutional reform.

V. DECENTRALIZATION ISSUES: THE HISTORICAL-INDUSTRIAL ENVIRONMENT

The unincorporated sector is influenced in its current location choices by historical location patterns. Getting plants to go to new locations is inherently

difficult, since those locations are poor information environments. To induce plants to go to decentralized new locations would require a program to make those locations sufficiently attractive to overcome historical patterns (see Rauch 1993 for a theoretical treatment of this problem). Moreover, we argue that historical centralization of the corporate sector in Indonesia contributes to enhanced centralization of the unincorporated sector.

To assess the effects of history on current locational choices, we reevaluate the coefficients in table 4. Given the normalization in estimation, another way to interpret the coefficients is to look at percentage changes in probabilities evaluated at the probability for a representative location. The representative location is defined for each industry as a hypothetical location having mean values across geographic areas for all right-hand-side variables. To give a better sense of magnitudes of changing the values of right-hand-side variables, we report the effect of changing each variable's value by one standard deviation on the relative probability of the hypothetical representative location attracting the industry. That is, first we calculate $\overline{P}$, where

$$(5) \qquad \overline{P} = \frac{\exp(\beta\overline{X})}{\displaystyle\sum_{k=1}^{M} \exp(\beta X_k)} \qquad\qquad \overline{x} = \sum_{k=1}^{m} x_k \ / \ M$$

and then we calculate

$$(6) \qquad \frac{\Delta P}{\overline{P}} = (1 - \overline{P})\beta\Delta x$$

where Δx equals the standard deviation for x about its mean. These results are given in table 5. Given 106 locations $1 - \overline{P} \rightarrow 1$, so generally $\Delta P / \ \overline{P} \approx \beta\Delta x$.

We know that unincorporated firms are strongly influenced in their choices of location by the existing industrial environment. Table 5 tells us that a one-standard-deviation increase in past own-industry employment increases a location's probability of attracting a plant by 14 to 35 percent (except for publishing and paper). In other words, the proportion of new plants in Java that the location attracts rises by these percentages. Similarly, a one-standard-deviation *decrease* in HHI for manufacturing would increase the probability by 2 to 24 percent, and in HHI for all industries by 18 to 51 percent (except for nonmetallic minerals). For the maturity index, the probability increases by 12 to 26 percent.

These numbers suggest that a location's industrial environment, which has been built up over time, has a strong impact on its ability to attract plants today. Consider a simple experiment where we give a representative interior location an industrial environment shock, improving the environment by one standard deviation each for past employment, the two HHIs, and the maturity index. Taken together, that raises the proportion of new plants the location will attract by

Table 5. *Impact on Location Probabilities of a One-Standard-Deviation Increase in the Variables, Java, 1980–85*
(percent)

Variable	Textiles	Furniture and wood products	Nonmetallic minerals	Machinery	Publishing and paper	Miscellaneous
Wages	−0.65	−0.13	(0.03)	(−0.25)	−0.02	−0.38
ln population	0.64	(0.32)	0.45	0.21	1.14	(0.06)
ln 1980 own-industry employment	0.35	0.20	0.23	0.14	0.00	0.17
HHI: manufacturing[a]	−0.24	(−0.06)	−0.11	−0.08	−0.02	−0.15
Maturity index[b]	0.13	0.26	0.22	(0.12)	(0.14)	0.12
HHI: all industries[a]	−0.49	−0.20	(0.09)	(−0.21)	−0.18	(−0.51)
Cumulative for environmental improvement[c]	1.21	0.72	0.47	0.55	0.34	0.95
Percentage existing plants with a generator[d]	−0.19	(−0.06)	−0.09	(0.10)	(0.04)	−0.05
Distance[e]	−0.44	(−0.28)	−0.13	−0.40	−1.17	−0.50

Note: The values in the table are the percentage change in a representative location's probability of attracting a plant, caused by a one-standard-deviation increase in the variable. The representative location is defined for each industry as a hypothetical location having mean values across geographic areas for all right-hand-side variables. See the text for details on the calculations. The numbers in parentheses are based on coefficients with t-statistics less than one.

a. The Hirschman-Herfindahl index (HHI) for manufacturing is a measure of diversity of manufacturers. It is the sum of squared shares of employment by two-digit manufacturing industry in all other manufacturing. The HHI for all industries measures local economic diversity. It is the sum of squared shares of one-digit employment in all employment.

b. Maturity of the manufacturing environment is measured by an employment-weighted average of the age of all old manufacturing plants outside the own industry in the *kabupaten*, divided by the national average for each industry.

c. In calculating cumulative effects, effects of 1980 own-industry employment and of the maturity index are added to the negative of the two HHI index effects.

d. Existing plants are those in existence in 1985 that were established before 1980.

e. Distance is measured as the straight-line distance from the center of a *kabupaten* to the center of the nearest of the four metro areas in Java.

Source: Authors' calculations.

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121 percent for textiles, 72 percent for wood and furniture, 47 percent for non-metallic minerals, 55 percent for machinery, 34 percent for publishing and paper, and 95 percent for miscellaneous. The publishing and paper industry, which is dominated by local printing activity, is the least sensitive to the industrial environment shock. The next step is to argue that this environmental shock is a very relevant experiment.

From tables 1 and 2 we saw that the large corporate sector is highly centralized in Indonesia. We have argued that centralization is driven by access to export nodes and by centralization of governmental and financial institutions. Unincorporated firms traditionally did not need to centralize to the same extent because they export little and they were precluded typically from interacting extensively with many central institutions. They were relatively freer to locate in decentralized places (even though we argued that access to major metro areas remains unusually important for them). However, the centralization of the corporate sector itself acts as a magnet drawing the unincorporated plants to the center, so they can enjoy the external benefits of greater existing own-industry employment, greater diversity of the industrial environment, and greater maturity of the established corporate firms. In short, centralization of the corporate sector increases the degree of centralization of the unincorporated sector, and further disadvantages decentralized locations. Moreover, this pattern cannot be changed overnight. To attract more unincorporated plants, decentralized locations would need to attract and *retain* a disproportionate share of new corporate plants to build up their industrial base.

It is hard to know what Indonesia would look like in the absence of centralization of the corporate sector, but here we describe a suggestive experiment. Suppose, for example, that the proportion of *all* manufacturing outside the 50-kilometer radius of the four major metro areas in Java is increased to that of the unincorporated sector. Such a shift in manufacturing employment would double all manufacturing outside the four metro area regions. The resulting effect on the flows of new unincorporated plants would be similar to our one-standard-deviation improvement in industrial environment for the representative city. For example, a doubling of past own-industry employment in the representative interior city represents just under a one-standard-deviation increase in its employment. Such a difference in starting point would strongly increase the proportion of new unincorporated plants going to decentralized locations.

VI. REGIME SWITCHES: INSTITUTIONAL CENTRALIZATION

In our data there are effectively two regime switches concerning centralization. The first is the difference in locational patterns in the incorporated and unincorporated sectors. It is obvious that the corporate sector is highly centralized. The estimation results discussed in the appendix show that traditional market

forces and externalities are less important for the corporate sector. Population effects and access to major metro areas drive location decisions almost entirely.

Here we focus on the second regime switch, the change in locational determinants of the unincorporated sector after the 1983 announcement of liberalization. This comparison will show that liberalization actually may work to increase centralization. To assess the effect of liberalization on centralization, we compared coefficients for unincorporated plants established in 1980–82 with those established in 1983–85. In table 6 we report a general comparison where all coefficients are allowed to vary between 1980–82 and 1983–85; then in table 7 we report a comparison where only the distance coefficient is allowed to vary. Our focus is on the distance variable, but we first comment on issues concerning some general comparisons.

The general comparison has some underlying conceptual difficulties that reflect the problem of our data not being panel data. We study location decisions, based on 1980 conditions, for plants that were established between 1980 and 1985. Plants established in 1980 may react differently to 1980 conditions than plants established in 1985. In particular, there may be a lag structure to prior conditions; the difference in coefficients before and after 1983 may pick up the lag structure in addition to the impact of liberalization. For example, in table 6 for most of the industries, the post-1983 coefficients are more negative for wages and for HHI for all industries. For all industries, the post-1983 coefficients are less positive for past employment. These may simply reflect lag structure effects. Additionally, infrastructure coefficients post-1983 tend to be less negative, another possible result of the lag structure.

In terms of decentralization and liberalization, the two variables of direct interest are population and distance. In table 6, except for textiles, the population coefficient post-1983 is more positive; and the distance coefficient is more negative in all industries except nonmetallic minerals. However, in attempting to pare down the coefficient list to the key post-liberalization variables (distance, wages, population, past employment), only distance survived as a consistently critical variable in any set of combinations. For example, if we start with distance as the only post-1983 coefficient to differ and add in population, it only adds significantly to explanatory power (by a χ^2 test) in one industry. The same comment applies to wages, past employment, and infrastructure.

In table 7 we focus on distance variables. The first row in table 7 lists the distance coefficient from table 4. Note that while table 7 reports coefficients, the proportional difference in probability elasticities is almost identical in magnitude (see equation 5). The second and third rows in table 7 give the values for the basic distance coefficient and the post-1983 slope premium estimated from a reduced-form model. In the reduced-form model, all direct and indirect (for example, population) post-1983 distance effects are captured in the premium coefficient. The fourth and fifth rows in table 7 give the corresponding basic and post-1983 distance effects when all other coefficients are also allowed to vary after 1983 (see table 6).

Table 6. *Logit Results with Slope Dummies for All Variables for the Unincorporated Sector, Java, 1980–85*

Variable	Textiles	Furniture and wood products	Nonmetallic minerals	Machinery	Publishing and paper	Miscellaneous
ln wages	-1.56*	-0.018	0.426*	-1.14*	0.140	-0.499
Post-1983 premium	-0.497*	-0.647*	-0.621*	0.775*	-0.309	-0.894*
ln population	1.02*	0.043	0.605*	0.237*	-0.039	-0.837*
Post-1983 premium	-0.069	0.790*	0.208	0.119	0.175	1.48*
ln own-industry employment	0.414*	0.478*	0.357*	0.338*	0.209	0.879*
Post-1983 premium	-0.057	-0.410*	-0.136	-0.424*	-0.345*	-1.08*
HHI manufacturing[a]	-1.35	-1.25*	-1.85*	-0.046	0.416	0.123
Post-1983 premium	-2.83*	1.04	0.791	-1.91	-1.34	-3.78*
Maturity index[b]	1.01*	0.880*	0.847*	0.267	0.371	0.283
Post-1983 premium	-0.988*	0.111	0.256*	0.352	0.127	0.312
HHI all industries[a]	-11.85*	-1.29	1.91*	-4.12*	0.950	-0.402
Post-1983 premium	-0.635	-1.85	-1.47	2.69	-5.44	-9.45*
Percentage of existing plants with a generator[c]	-0.035*	-0.017*	-0.028*	0.0063	0.047	-0.039*
Post-1983 premium	0.010	0.014	0.026*	0.017	-0.00027	0.047*
Distance[d]	-0.402*	-0.263*	-0.158*	-0.109	-0.933*	-0.553*
Post-1983 premium	-0.260*	-0.131*	0.013	-0.761*	-0.661*	-0.066

Note: To calculate coefficients for overall post-1983 effects, add the post-1983 premium to the base effect.

* Indicates that the variable is significant at the 10 percent level on the basis of uncorrected standard errors.

a. The Hirschman-Herfindahl index (HHI) for manufacturing is a measure of diversity of manufacturers. It is the sum of squared shares of employment by two-digit manufacturing industry in all other manufacturing. The HHI for all industries measures local economic diversity. It is the sum of squared shares of one-digit employment in all employment.

b. Maturity of the manufacturing environment is measured by an employment-weighted average of the age of all old manufacturing plants outside the own industry in the *kabupaten*, divided by the national average for each industry.

c. Existing plants are those in existence in 1985 that were established before 1980.

d. Distance is measured as the straight-line distance from the center of a *kabupaten* to the center of the nearest of the four metro areas in Java.

Source: Authors' calculations.

Table 7. *Impact of Liberalization on the Importance of Access for the Unincorporated Sector, Java, 1980–85*

Model and variable	Textiles	Furniture and wood products	Nonmetallic minerals	Machinery	Publishing and paper	Miscellaneous
Full model[a]						
Distance	−0.53	−0.33	−0.15	−0.48	−1.31	−0.58
Model with distance dummy alone						
Distance	−0.28	−0.20	−0.12	−0.20	−1.0	−0.37
Post-1983 premium	−0.48	−0.22	−0.05	−0.56	−0.52	−0.39
Model with distance dummy and all other dummies[b]						
Distance	−0.40	−0.26	−0.16	−0.11	−0.93	−0.55
Post-1983 premium	−0.25	−0.13	0.01	−0.76	−0.66	−0.06

Note: Distance is measured as the straight-line distance from the center of a *kabupaten* to the center of the nearest of the four metro areas in Java. To calculate coefficients for overall post-1983 effects, add the post-1983 premium to the base effect.

a. See table 4.
b. See table 6.

Source: Authors' calculations.

The pattern is clear in table 7: with the addition of the post-1983 effects, post-1983 distance effects are much stronger than pre-1983 effects. The only exception is nonmetallic minerals, where the distance effect is weakest, and perhaps miscellaneous manufacturing, where indirect distance effects dominate. Particularly for machinery and publishing and paper, direct post-liberalization effects are very strong. They are also strong for textiles and wood and furniture products. Liberalization simply accentuated centralization tendencies for these industries.

As suggested earlier, centralization may have increased because unincorporated firms needed to centralize to take direct advantage of liberalization measures. Alternative explanations exist. For example, as noted earlier, the highly centralized corporate sector grew faster in this time period. Over time, this would help draw unincorporated firms into centralized locations to enjoy informational and other spillover benefits from the corporate sector. Of course, to the extent that liberalization spurred the enhanced growth of the corporate sector, that is still an indirect effect of liberalization on the location patterns of plants in the unincorporated sector. However, we believe that much of the initial increased centralization of the unincorporated sector should be ascribed to direct liberalization effects (for example, centralizing to effectively benefit from liberalization measures). The sharp switch in location patterns in table 2 at the 1983 liberalization argues for direct effects of the regime switch to liberalization. We would expect the indirect location response of the unincorporated sector to growth of the centralized corporate sector to be slow because it took time for that increased growth of the corporate sector to actually accumulate and generate externalities to attract unincorporated plants.

VII. CONCLUSIONS

In this article we estimate a model of location decisions for new manufacturing plants in Java, focusing on the unincorporated sector. We find that firm location decisions respond to typical market variables as expected, being adversely affected by higher wages, smaller local markets, and poorer infrastructure. We also find that the local historical industrial environment itself affects location decisions, an association we attribute to dynamic externalities. We interpret this finding as explaining why hinterland locations that lack a particular industry have trouble attracting that industry, even when government policies encourage decentralization. Plants strongly prefer locations with mature plants in related industries that offer a built-up stock of local trade secrets concerning local market conditions, local institutions and politics, and technology. Moreover, in Indonesia the extreme centralization of the corporate sector draws unincorporated plants to central locations so that they can take advantage of positive externalities from the corporate sector.

In this article we also find that, in contrast to other countries, access to centralized locations strongly influences location decisions in Indonesia, even after

controlling for other features of the hinterland. This influence is strongest for incorporated firms, which are most reliant on the centralized bureaucracy for financing, export-import licenses, and other aspects of business. For unincorporated firms, although access is relatively less important, it is still critical.

With this comment on access to central locations in mind, we associate the 1983 regime switch in Indonesia with increased centralization of the unincorporated sector. We believe that the increased centralization occurred because, although liberalization gave unincorporated firms better access to government and other centralized services, firms needed to centralize to take advantage of these opportunities because the bureaucratic process is centralized and communications are poor. The relative increased growth of the corporate sector following liberalization may have also helped to further draw unincorporated plants into centralized locations.

APPENDIX. RESULTS FOR THE CORPORATE SECTOR

In this appendix we present results for the logit model estimated just for new plants for 1980–85 in the corporate sector. Compared to the unincorporated sector, the number of new plants in the corporate sample is small. In the unincorporated sector, new plants span virtually all 106 *kabupatens*. In the corporate sector, for textiles, machinery, and publishing, new plants occur in only about 40 *kabupatens*, with a maximum of 55 in nonmetallic minerals. Given the limited number of locations covered, our results are noisy, but there are some startling patterns.

In table A-1, results are presented for five industries—the sample size for miscellaneous manufacturing was too small to utilize. The infrastructure variable either does not matter or is of perverse sign for all industries. For the corporate sector, access to reliable electricity is not an issue, presumably because the sector either has good access or can readily compensate. Therefore, we dropped it as an explanatory variable.

More generally, the corporate sector does not seem to be so driven by economic factors in choosing locations. Wages, the HHI for all industries, and past own-industry employment routinely all have perverse signs. The last suggests that the corporate sector is trying to spread out (for competitive reasons) and that good intraindustry information for its centralized plants is not so important. Population, the HHI for manufacturing, maturity, and distance have expected signs. Of these, distance is very strong.

Overall, the corporate sector results suggest that these firms are motivated less by conventional economic factors and more by the need to operate in traditional, populous, and centralized locations. To further show this, we constructed two sets of results. First, table A-2 presents the predicted probabilities that plants in the corporate and unincorporated sectors will locate in centralized locations— the *kabupaten* (*kotamadya*) of one of the four major metro areas. These marginal probabilities (that is, predicted for new plants) are compared with the

Table A-1. *Industrial Location for the Corporate Sector, Java, 1980–85*

Variable	Textiles	Furniture and wood products	Nonmetallic minerals	Machinery	Publishing and paper
In wages	−1.53*	0.262	−0.273	1.48*	0.547
In population	0.977*	0.616	1.45*	0.747*	−0.0019
In 1980 own-industry employment	−0.278*	−0.460	−0.746*	−0.778*	0.098
HHI: manufacturing[a]	−10.6*	−2.19*	−1.66	−7.85*	−1.61
Maturity index[b]	0.328	0.057	1.30*	0.721*	0.279
HHI: all industries[a]	−5.38*	2.01	2.40*	2.17	1.60
Distance[c]	−0.676*	−0.472*	−0.682*	−1.73*	−1.37*
Number of observations	353	177	172	341	316
Number of locations covered	39	51	55	41	38

Note: Coefficients are from logit estimation in which the dependent variable is the discrete choice of *kabupaten* in which to locate.

 * Indicates that the variable is significant at the 10 percent level on the basis of uncorrected standard errors.

a. The Hirschman-Herfindahl index (HHI) for manufacturing is a measure of diversity of manufacturers. It is the sum of squared shares of employment by two-digit manufacturing industry in all other manufacturing. The HHI for all industries measures local economic diversity. It is the sum of squared shares of one-digit employment in all employment.

b. Maturity of the manufacturing environment is measured by an employment-weighted average of the age of all old manufacturing plants outside the own industry in the *kabupaten*, divided by the national average for each industry.

c. Distance is measured as the straight-line distance from the center of a *kabupaten* to the center of the nearest of the four metro areas in Java.

Source: Authors' calculations.

average probabilities for these sectors—the proportion of the stock of firms in different industries in one of the four major metro areas. The marginal and average probabilities within each sector are similar.

The comparison of probabilities for the incorporated sector compared with those of the unincorporated sector confirms the raw employment data patterns in tables 1 and 2. Both in terms of marginal and average probabilities, the corporate sector is much more centralized than the unincorporated sector. This is due not just to a distance effect, but to the much stronger population effects in the corporate sector (for furniture and wood products, nonmetallic minerals, and machinery), and the much stronger diversity effects for manufacturing for all industries.

Second, in table A-2 we look at the impact of the distance variable itself, in the corporate sector compared with the unincorporated sector. This compari-

Table A-2. *The Importance of Distance in the Corporate and Unincorporated Sectors, Java, 1980–85*

Measure and sector	Textiles	Furniture and wood products	Nonmetallic minerals	Machinery	Publishing and paper
Predicted probability of a plant being in one of eleven central kabupatens					
Unincorporated sector	0.46	0.19	0.14	0.30	0.54
Corporate sector	0.64	0.42	0.29	0.58	0.70
Proportion of stock of plants in central kabupaten					
Unincorporated sector	0.48	0.19	0.11	0.35	0.56
Corporate sector	0.62	0.62	0.35	0.62	0.77
Percent change in locational probability with a one-standard-deviation increase in distance					
Unincorporated sector	−0.44	−0.28	−0.13	−0.40	−1.17
Corporate sector	−0.56	−0.40	−0.59	−1.44	−1.22

Source: Authors' calculations.

son tells us the effect of access itself, once we have controlled for other aspects of hinterland locations. In table A-2 we report distance elasticities for the representative (hinterland) location given in table 5. We analyze the impact on the probability of the representative *kabupaten* attracting plants, if the distance variable is increased by one standard deviation. In all cases, the negative effect is larger in the corporate sector—enormously so for nonmetallic minerals and machinery.

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Guidelines on Searching for a Dalton-Improving Tax Reform: An Illustration with Data from Indonesia

Shlomo Yitzhaki and Jeffrey D. Lewis

This article documents the search for a Dalton-improving tax and expenditure reform using a methodology developed by Yitzhaki and Slemrod (1991) and Mayshar and Yitzhaki (1995). The methodology overcomes the need to define a specific social welfare function by searching instead for reforms that improve each social welfare function belonging to a wide class of functions. The authors apply the method to the energy sector of Indonesia, ignoring distributional constraints, and find that both the subsidy on kerosene and the tax on gasoline should be reduced. But taking distributional concerns into account, the present structure of energy taxes is reasonable and the country may benefit by increasing the subsidy to kerosene, taxing electricity, and reducing the gasoline tax. These conclusions are robust to changes in the relevant parameters representing the Indonesian economy.

This article illustrates the search for a Dalton-improving tax and expenditure reform using a methodology developed by Yitzhaki and Slemrod (1991) and Mayshar and Yitzhaki (1995).[1] The goal of this methodology is to eliminate the need to define a specific social welfare function. Instead, we search for reforms that improve each social welfare function belonging to a wide class of functions. Avoiding the definition of a specific social welfare function reduces the bias often inherent in such reforms: because governments are unable to specify a social welfare function on their own, the proposed reforms often represent the social views of advisers, which need not coincide with those of the client governments. Although professional advice on income distribution is never value free, use of the Dalton-improving principle reduces the significance of the value judgments embedded in such advice.

Dalton-improving reforms require the same data as social welfare-based tax reforms. Thus no savings are made with respect to data collection. But the reliance on data is weaker under Dalton-improving reforms. For example, both

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1. See Martina (1993) for applications of the methodology in other areas of economics.

types of reforms require revenue estimates; although regular reforms may be sensitive to the exact magnitude of these estimates, Dalton-improving reforms are not affected if the estimates are multiplied by a constant.

I. The Search for a Dalton-Improving Reform

Hugh Dalton, a British economist, was the first to suggest that a transfer from a rich person to a poor person increases social welfare (Dalton 1949). Dalton improvement is weaker than Pareto improvement, which asserts that society benefits if the income of at least one member increases, provided that the incomes of all other members do not fall. By contrast, a Dalton-improving reform allows the income of an individual to fall, provided that the incomes of one or more poorer individuals increase by at least the same amount.

Searching for a Dalton-improving reform first requires ranking the population according to its economic well-being. A definition of well-being must be agreed upon to allow determination of who is rich and who is poor; such a distinction is needed to decide whether a transfer will increase or decrease social welfare. The definition of well-being can be expanded; for example, Mayshar and Yitzhaki (forthcoming) allow well-being to be affected by two parameters— ability and needs. Given ability, the greater the needs, the lower the well-being of a household; and, given needs, the greater the ability of the household, the higher its well-being. This kind of extension is useful for handling family size, in which needs increase with the number of children, or rural-urban distinctions, in which rural populations might need less income to achieve a certain level of well-being than do urban populations (Ravallion 1993).

The technical requirements and implications of such extensions are beyond the scope of this article. Instead, the empirical illustration reported later uses expenditure per capita as the sole indicator of economic well-being. Because expenditure per capita is used only to rank households, any monotonic transformation of this measure can be used without affecting the findings.

Dalton described the effect of transfers from rich to poor—not of transfers between equally rich or equally poor individuals. Differential treatment of equally rich or poor individuals is referred to as horizontal inequity. In our analysis we allow transfers to be made between individuals that are equally well-off; furthermore, we assume that society is indifferent to such transfers. This assumption enables us to aggregate households with equal economic well-being.[2]

Types of Reform

We restrict the search for a Dalton-improving reform to finding the direction of the desired tax reform (that is, determining which taxes or subsidies will in-

2. Note that indirect taxes tend to tax equal individuals differently. For a discussion of different interpretations of horizontal inequity, see Lambert and Yitzhaki (1995). Mayshar and Yitzhaki (forthcoming) extend the method to deal with Dalton-improving reforms in which transfers between certain types of individuals are not allowed.

crease or decrease and in what proportions), rather than the exact magnitudes of changes in tax rates. The methodology of a Dalton-improving reform is applicable to nonmarginal reforms. However, we will restrict the application to marginal reforms. The main advantage is the smaller data requirements: the analysis of a marginal reform relies mostly on observed data, while analysis of a nonmarginal reform typically relies on estimated or synthetic data on households.

An immediate question arises: How restrictive is the assumption of a marginal reform, and does this assumption make the methodology irrelevant for evaluating practical tax reforms? Technically, an approximation based on knowing only the appropriate direction is applicable whenever first-order approximations do not lead to gross errors. But this textbook answer is not very useful. Looking further, Willig (1976) investigated the accuracy of estimates of consumer surplus from demand curves and showed that such approximations depend on a commodity's share in total consumption and on income elasticities. The smaller the share, the greater the accuracy—that is, the less a change in a commodity's price affects the accuracy of the approximations. Similarly, the higher the income elasticity, the less accurate are the approximations.

Also critical are the properties of Dalton-improving reforms. Empirically, it is important that the reforms do not drastically change the household ranking. A useful rule of thumb holds that if the reform does not change incomes by more than 10 percent, a marginal analysis is reasonable. But if one intends to make the poor rich and the rich poor, marginal analysis is not appropriate.

Tax-Shifting Assumptions

Tax-shifting assumptions allow for additional data savings. A general equilibrium model is required to determine the distributional effect of the portion of the tax absorbed by firms, households (the suppliers of factors of production), and the economy. Most computable general equilibrium (CGE) models generally assume that all production functions are homogeneous of degree one and that there is perfect competition—which is equivalent to assuming that taxes are borne by consumers. For simplicity we assume such shifting to consumers as well, although there is nothing in the method that prevents the introduction of complex tax shifting into the calculations.

Revenue Neutrality

It is easier to analyze revenue-neutral reforms because we can ignore the issue of the optimal size of government activity. But ignoring this issue is another convenient assumption and can be discarded, provided that the appropriate data—each household's willingness to pay for public goods—are available. Partial relaxation of this requirement will be illustrated later.

Externalities

Ignoring externalities is yet another simplifying assumption. It should not be difficult, however, to incorporate the effects of externalities into the calcula-

tions, provided that we can obtain the appropriate data or, alternatively, make the necessary assumptions regarding the effect of the externalities. If externalities affect a public good, then we would need to know each household's willingness to pay. Eskeland and Kong's (1994) framework is a good example of an approach that can be incorporated into the search for Dalton-improving reforms.

II. CHARACTERIZATION OF A DALTON-IMPROVING REFORM

Consider a household with a well-behaved utility function $u^h(\cdot)$, unknown to us, and a known budget allocation, $y^h = \sum_i q_i x_i^h$, where q_i is the consumer price of the ith commodity; x_i^h is the quantity of that commodity consumed; and y^h is the household's exogenously given income. Commodities may include factors of production, such as labor, in which case the consumed quantity of the commodity is nonpositive. Assume that producers' prices (p_i for the ith good) are given and that $t_i = q_i - p_i$ are the tax rates. Then, the effect of a marginal tax reform on the household, or marginal benefit, is

$$(1) \qquad\qquad MB^h = -\sum_i x_i^h dq_i + dy^h.^3$$

A Dalton-improving reform can be viewed as the combination of the allocation of manna from heaven (arriving because of a reduction in deadweight efficiency loss, or excess burden) and transfers from rich to poor households. MB^h is the first-order approximation of the effect of the reform on household h, evaluated in monetary terms.

Under the Dalton criterion, $MB^1 \geq 0$ must hold for the poorest (first) household, otherwise the poorest household has not received its share of manna or a transfer from a richer household. If $MB^1 < 0$, the poorest household is making a transfer to others, in violation of the Dalton criterion.

Now consider the second poorest household. The Dalton criterion restriction on the marginal benefit to this household requires that $MB^1 + MB^2 \geq 0$, which means that the combined first and second household "poor" must be better off. Note that MB^2 can be negative, in which case the reform involves a transfer from the second poorest to the poorest household.

By similar reasoning, it can be shown that a Dalton-improving reform has to fulfill the general condition

$$(2) \qquad\qquad \sum_{h=1}^{k} MB^h \geq 0, \text{ for } k = 1, 2, 3\ldots H,$$

where H is the number of households in the economy.

We can offer an additional interpretation of equation 2. Consider a social planner who wants to reduce the poverty gap but does not know who is

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3. We can derive this relationship under two alternative sets of assumptions. First, the household is a utility maximizer, and, by Roy's identity, $\partial v^h(\cdot)/\partial t_i = -\lambda^h x_i^h$, where v is the indirect utility function and λ is the marginal utility of income. The marginal benefit is the income equivalent of the change caused by the reform. Second, no optimization is carried out by the household, and we are interested only in a Slutsky compensation to the household.

poor. To be on the safe side, it is best to reduce poverty gaps for *any* possible poverty line. Equation 2 is the necessary and sufficient condition for such a strategy.

A simple change in equation 2 will allow us to adapt the Dalton-improving reform to more specific poverty criteria. If the social planner is willing to commit to an upper bound for the poverty line, then equation 2 can be restricted to the subset of households that are potentially poor, and all other households can be aggregated into one group. Another poverty target is to insist that the reform raise all incomes above a given threshold. Accommodating such a restriction requires that additional constraints be imposed on the lowest inequalities in equation 2. Such an extension is feasible but beyond the scope of this article.

III. Tax Instruments

Equation 2 defines the target function for the tax reform, which is subject to the constraint that the reform be revenue neutral. Each tax instrument (which may be a tax rate, an exemption, or any aspect of the tax function) involved in the reform is characterized by two kinds of parameters. The first parameter reflects the effect on the target function and is later referred to as the *distributional characteristics* of the instrument.[4] The second parameter reflects the impact on the revenue constraint and is referred to as the marginal efficiency cost of public funds (MECF). The MECF reflects the cost to society of the revenue raised by changing the tax instrument.

Distributional Characteristics

Substituting equation 1 into the left-hand side of equation 2 gives

$$(3) \qquad \sum_{h=1}^{k} MB^{h} = -\sum_{h=1}^{k} \sum_{i} x_{i}^{h} dq_{i} + \sum_{h=1}^{k} dy^{h}.$$

By changing the order of summation and dividing and multiplying by $X_i = \sum_h x_i^h$, the "quantity demanded" of the tax base i (which for indirect taxes is commodity i), we get

$$(4) \qquad \sum_{h=1}^{k} MB^{h} = -\sum_{i} X_{i} dq_{i} \left(\sum_{h=1}^{k} x_{i}^{h} / X_{i} \right) + \sum_{h=1}^{k} dy^{h}.$$

The term $\sum_{h=1}^{k} x_i^h / X_i$ is the cumulative share of commodity i consumed (held) by the k poorest households. This term reflects the distributional characteristics of the tax instrument. It is portrayed by the concentration curve of the commodity, which is a variation of the well-known Lorenz curve (Kakwani 1977 describes the properties of concentration curves).

The data required for constructing concentration curves can be found in any survey of family expenditure. In this article we use the National Social Economic Survey, or SUSENAS (Government of Indonesia 1990). Since we deal only with indirect tax reforms, $dy^h = 0$ for all households.

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4. Feldstein (1972) coined the term distributional characteristics and showed its relevance in taxation.

Marginal Costs of Funds

An important consideration in any tax reform is the expected change in revenue. In this section we show that embedded in these revenue estimates is the estimate of the marginal deadweight loss that can be recovered through the revenue estimates.

Government tax revenue is

$$(5) \qquad R(t,p,y) = \sum_i t_i X_i (p+t,y)$$

where $X_i (q, y)$ is the demand for commodity i; y is a vector of incomes; t is a vector of specific taxes; and consumer prices are $q = p + t$. Revenue neutrality requires that

$$(6) \qquad dR = \sum_i MR_i dt_i = 0$$

where $MR_i = \partial R/\partial t_i$ is the change in overall tax revenue resulting from a small change in the tax rate on commodity i. As it turns out, it is convenient to work with revenue changes expressed in monetary terms rather than with tax parameters, which may have different units. Hence the change in tax revenue (denoted by δ_i) that results from a change in the tax rate on commodity i (dt_i) becomes

$$(7) \qquad \delta_i = MR_i dt_i.$$

The marginal tax reform, dt, could also be characterized by the vector of tax receipts, δ. And the change in tax revenue would then be $dR = \sum_i \delta_i$.

Substituting equation 7 into equation 4 and taking into account that $dt_i = dq_i$ and $dy^h = 0$ for all h, the Dalton criterion becomes

$$(8) \qquad \sum_{h=1}^{k} MB^h = -\sum_i (X_i / MR_i) \delta_i \left(\sum_{h=1}^{k} x_i^h / X_i \right) \geq 0, \quad \text{for } k = 1, 2 \ldots H$$

subject to $\sum_i \delta_i = 0$.

The term X_i/MR_i is the marginal efficiency cost of public funds. To illustrate, we concentrate on the last inequality in equation 8, when $k = H$. This is the representative consumer case in which distributional considerations are ignored. Equation 8 becomes

$$(9) \qquad \sum_{h=1}^{H} MB^h = -\sum_i (X_i / MR_i) \delta_i \text{ subject to } \sum_i \delta_i = 0.$$

A neutral tax reform, involving only two taxes, will reduce deadweight loss if

$$(10) \sum_{h=1}^{H} MB^h = -[(X_1 / MR_1) \delta_1 - (X_2 / MR_2) \delta_1] = (MECF_2 - MECF_1)\delta_1 > 0.$$

It can be easily seen that if $MECF_2 > MECF_1$, the reform will have an efficiency gain only if $\delta_1 > 0$, and if $MECF_2 < MECF_1$, the reform will have an efficiency gain only if $\delta_1 < 0$.[5]

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5. Note that if any two MECFs are not equal, then we can design a Pareto-improving tax reform, provided that lump-sum taxes exist.

To estimate the marginal efficiency cost of public funds, two parameters for each tax instrument must be evaluated: the marginal change in revenue, MR_j, and the tax base X_j, which is the expected change in tax revenue assuming no other changes occur.

In many estimations, X_j is also used as an estimate of MR_j. The interpretation in those cases is that all marginal efficiency costs of public funds are assumed to be equal. But in this article we relax this simple assumption and use a CGE model for Indonesia that can estimate these costs individually (Lewis 1993). A brief description of the model is given in the appendix.

Characterization of the Solution

The problem solved is that defined in equation 8. That is, we must determine the $\delta_i (i = 1 . . .n)$ that satisfy the inequalities in that equation. In many cases equation 8 will have no feasible solution or an infinite number of solutions. We will be interested in finding one feasible solution, and, if possible, characterizing the feasible set. Since the trivial solution, $\delta_i = 0$ for all i, satisfies the constraints, one commodity should be chosen as a numeraire, with $\delta = 1$ or $\delta = -1$. We must try both cases because we do not know whether the tax on the numeraire should be increased or decreased. Also, any convex combination of two solutions is feasible.[6] Thus by finding two Dalton-improving tax reforms, one with a positive change in the tax rate j and the other with a negative change, we can find a Dalton-improving reform with no change in tax rate j. In this case we can conclude that instrument j is not essential for a Dalton-improving reform.

In order to search for solutions, a numerical optimization algorithm is used to solve the following problem:

$$(11) \qquad \underset{\delta}{Min} \sum_k \{Max \, [-CMB^k (\delta), 0]^2 \}, \text{ subject to } \sum_i \delta_i = 0; \, \delta_1 \neq 0$$

where $CMB^k = \sum_{h=1}^{k} MB^h$ is the cumulative marginal benefit of all households poorer than or just as poor as household k. A feasible marginal tax reform, δ, will be considered a solution if the value of the objective function in equation 11 is zero. Since a solution requires that the target function equal zero, it is easy to verify that the numerical optimizer reaches a solution. The algorithm used for the search is described in Yitzhaki (1982), but any algorithm for numerical optimization can be used.

In general, there may be several (or an infinite number of) solutions to equation 11, and we do not have a methodology for finding all of them. For each numerical problem that we solve, we may find one solution. But it can be shown that the set of solutions forms a convex cone, implying that for a small number of instruments we can characterize the whole efficient set. For example, if only three tax rates are considered, then there will be only one

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6. To see this, note that a "solution" means that the cumulative gain is nonnegative for all k ($\sum_{h=1}^{k} MB^h \geq 0$). Imagine that you have found two such solutions. Then any convex combination of the two will also be nonnegative for all k.

independent variable, and the efficient set will form a segment on the real line. Searching for extreme solutions enables us to wholly characterize the efficient set.

The set of solutions to equation 11 defines the feasible set of Dalton-improving reforms. In general, we will be satisfied if we find one solution that belongs to the set. If the set includes more than one solution and we can characterize the whole set, the question to be asked is how to choose among solutions. One possibility is to add other constraints. For example, we could require that a Dalton improvement take place for both rural and urban populations or, alternatively, for several subgroups of the population, such as different-size households (see Mayshar and Yitzhaki, forthcoming). Another possibility is to choose a Dalton-improving reform that maximizes the number of beneficiaries—making it the most "populist" option. Those extensions are beyond the scope of this article.

IV. MORE ON DISTRIBUTIONAL CHARACTERISTICS

Ignore, for the time being, the marginal cost of funds. We can assume that taxes are lump sum, or that their marginal efficiency costs of public funds are equal. The distributional characteristics of a tax instrument are described by a concentration curve. The concentration curve of commodity j depicts the cumulative share of aggregate expenditure on that commodity against the ranking order of households, which are arranged in increasing order of economic well-being. The concentration curve is constructed analogously to the Lorenz curve, except that the vertical axis represents the cumulative share of a tax base (commodity) rather than income. By construction, each concentration curve extends from zero (for $h = 0$) to 1 (for $h = H$). The income elasticity of the commodity can be inferred from the curvature: if the concentration curve is convex, then the income elasticity is greater than zero; if the curve is concave, the elasticity is negative; and if it is a straight line, the elasticity is zero. An inferior good will thus have a concentration curve above the diagonal, and the curve of a neutral good will coincide with the 45-degree line. If the income elasticity is one, the Lorenz and the concentration curves will be identical, and if the elasticity is greater than one, the concentration curve will fall below the Lorenz curve. Since income elasticity can change over the range of the income distribution, it is possible for the concentration curve to follow an irregular path between the starting point (0, 0) and the ending point (1, 1) (figure 1).

In general, concentration curves tend to intersect, making it difficult to determine the characteristics of the appropriate Engel curve from their movements. This, in turn, makes it difficult to grasp the intuition and logic of Dalton-improving reforms. Fortunately, we can derive necessary conditions for Dalton-improving reforms using modified versions of regular income elasticities. For this purpose it is convenient to summarize the curvature of the concentration

Figure 1. *Distributional Characteristics of Commodities*

Cumulative share of consumption

Cumulative share of households
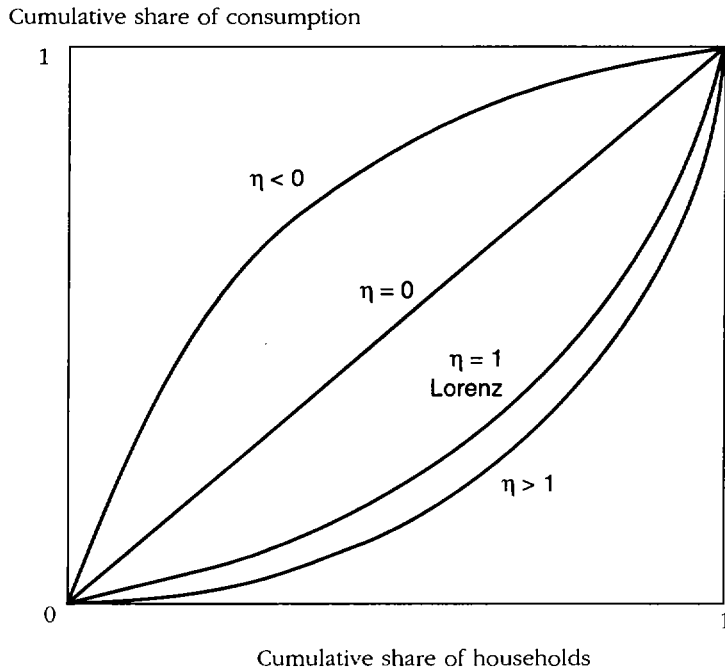
Note: Cumulative share of households is from the lowest- to the highest-income.
η is the (Gini) income elasticity of commodities.

curve by a coefficient, known as the Gini income elasticity of a commodity.[7] Construction of this coefficient is as follows.

The area between the Lorenz curve and the 45-degree line is equal to $\text{cov}[y, F(y)]/\mu_y$, where μ_y and $F(y)$ are the mean and the cumulative distribution of expenditure per capita, respectively. The term $\text{cov}[y, F(y)]$ resembles a variance measure, but with a cumulative distribution substituted for the variate. Similarly, the area between a concentration curve of commodity x_i and the 45-degree line is equal to $\text{cov}[x_i, F(y)]/\mu_i$, where μ_i is the mean expenditure on commodity i. Given the basic components that resemble the coefficient of variation and the covariance, the Gini income elasticity of a commodity is

(12)
$$\eta_i = \frac{\text{cov}[x_i, F(y)]\mu_y}{\text{cov}[y, F(y)]\mu_i}.$$

There are three interpretations of η_i:

* η_i is equal to the area between the 45-degree line and the concentration curve divided by the area between the 45-degree line and the Lorenz curve;

7. See Lerman and Yitzhaki (1994), Yitzhaki (1994), and the references therein for the derivation of the coefficient and other alternative interpretations of those coefficients.

- η_i is equal to a weighted average of the income elasticity of commodity i, with the weights derived from the Gini coefficient (Yitzhaki 1994);
- η_i is equal to the ratio of the Gini regression coefficient of the marginal propensity to spend on commodity i divided by the average propensity. To see that η_i resembles an elasticity, note that $b_i = \text{cov}[x_i, F(y)]/\text{cov}[y_i, F(y)]$ is the Gini regression coefficient of the slope of the regression curve of x as a function of y, which can be interpreted as a weighted average of the marginal propensity to spend, while μ_i/μ_y is the average propensity.[8]

An important property of this parameter is that a value greater or smaller than 1 determines whether a change in the tax on the commodity raises or lowers the Gini index of income inequality (Lerman and Yitzhaki 1994). Moreover, comparing the Gini income elasticities to each other and to 1 permits us to evaluate the impact of a tax on the Gini coefficient of economic well-being (Yitzhaki 1994).

V. DISTRIBUTIONAL CHARACTERISTICS OF COMMODITIES IN INDONESIA

The data we used came from the Indonesian Sample of Family Expenditure for 1990 (Government of Indonesia 1990). Expenditure per capita is used as a proxy for a household's economic well-being, and an individual is treated as the relevant unit by assigning a weight according to the number of individuals in the household. In order to simplify the calculations, the sample population is divided into 94 cells, each with 500 households (except for the last, which has 79 households).

As explained above, the marginal efficiency costs of public funds are calculated using a CGE model, derived from the 1985 social accounting matrix for Indonesia. One practical problem that arises when using two separate sources of data is the mismatching of classifications and levels of aggregation. On one hand, the family expenditure survey does not distinguish between imported and locally produced goods, although the CGE model was designed primarily to deal with such trade issues. On the other hand, the twenty-six-sector CGE model lacks the commodity detail of the expenditure survey. For example, it includes only one food processing sector, but the level of disaggregation in the survey goes as far as to distinguish between different types of cigarettes. To overcome this problem, we limited our search for Dalton-improving reforms to three commodities that are similarly defined in both data sources: electricity, kerosene, and gasoline. We also limited our analysis to the excise taxes or subsidies that were levied on these products. Historically, these rates have varied substantially. In 1980–81, for example, total subsidies to domestic fuel use averaged 17 to 18 percent of government routine expenditure, or nearly 2 percent of gross

8. For those who feel more comfortable with ordinary least squares (OLS), note that b_i can be interpreted as an instrumental variable estimator of the slope of the regression curve when $F(y)$ is used as an instrument for y.

Figure 2. *Concentration Curves of Energy-Producing Items, Indonesia*
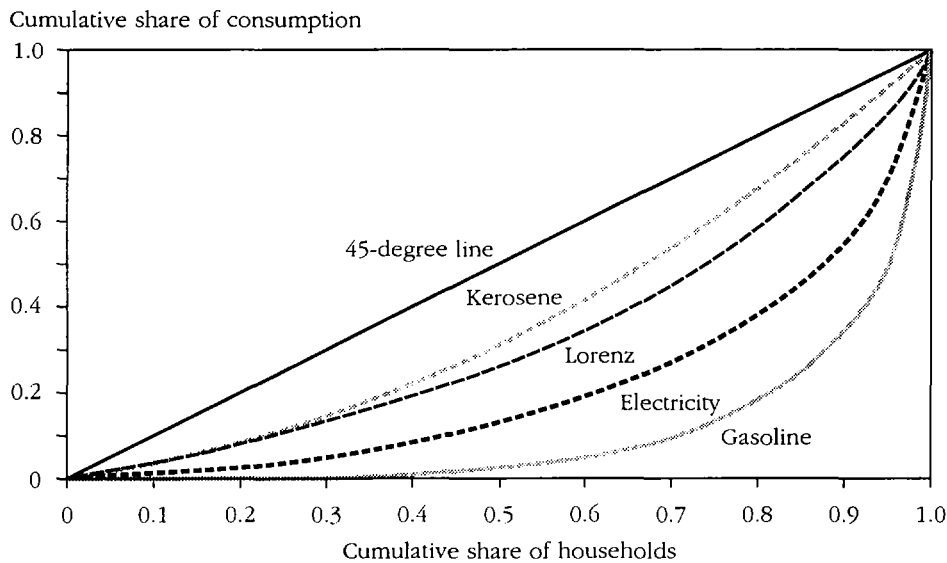
Cumulative share of consumption

Cumulative share of households

Note: Cumulative share of households is from the lowest- to the highest-income.
Source: Authors' calculations.

domestic product (GDP); but by 1985 (the year of the data used in this study) the total subsidy had dropped to only about 3 percent of routine expenditure.

The commodity with the lowest concentration curve is gasoline, indicating that gasoline has the highest income elasticity, which is greater than 1 (figure 2). Next comes electricity, with a concentration curve that is also below the Lorenz curve, meaning that the income elasticity of electricity is, on average, greater than 1. The concentration curve of kerosene is below the diagonal and above the Lorenz curve, which means that the income elasticity is bounded by 0 and 1.

The (Gini) income elasticity of kerosene is 0.59, indicating that kerosene is a necessity, whereas electricity has an income elasticity of 1.61 and gasoline 2.30 (table 1). As shown in Yitzhaki (1991), these are consistent estimates of the appropriate population parameters, and the asymptotic distribution converges

Table 1. *Gini Income Elasticities of Commodities, Indonesia*

Elasticity	Kerosene	Electricity	Gasoline	Q-cig.[a]	V-cig.[b]
Income elasticity	0.59	1.61	2.30	0.26	0.56
	(0.07)	(0.05)	(0.14)	(0.09)	(0.07)

Note: Income elasticity is calculated with respect to expenditure per capita. The population includes all Indonesian households separated into 94 groups, each with 500 observations, except for the last group. Households are ordered according to expenditure per capita. Jackknife standard errors are reported in parentheses (see Yitzhaki 1991).

a. Q-cig. is the income elasticity of purchased quantity of regular rolled cigarettes.

b. V-cig. is the income elasticity of expenditure on regular rolled cigarettes.

Source: Government of Indonesia (1990); authors' calculations.

to the normal. We can see from the standard errors that the income elasticities of these commodities differ significantly from one another.

The income elasticity of regular rolled cigarettes is included in order to demonstrate some of the properties of the analysis. The difference between the income elasticity of quantity sold of regular rolled cigarettes and the income elasticity of expenditure on this commodity (0.56–0.26) indicates that the income elasticity of price paid is 0.3 (the difference between the two).[9]

VI. DALTON-IMPROVING REFORMS

To begin the search for Dalton-improving reforms, we ask the following question: Is it possible to have a revenue-neutral Dalton-improving reform that is based on the change in the taxation of one commodity? The answer is yes, if we can tax the quality of the commodity.

To see this, consider the following case. A specific subsidy (that is, a subsidy to the quantity consumed) and an ad valorem tax are simultaneously imposed on the same commodity. The rates are defined so that the reform is neutral ($\delta_{Quant.} = -\delta_{Expend.}$). Since the marginal cost of funds for each of these two taxes should be equal, the way of finding such a tax reform is by plotting the difference between the concentration curves of quantity consumed and expenditure on that commodity. The vertical difference between the concentration curves (the DCC curve) is the cumulative marginal benefit from the reform. If the curve is nonnegative, then a revenue-neutral, one-commodity tax reform is identified. The DCC curve for regular rolled cigarettes shows that the cumulative gain is positive—thus a Dalton-improving reform exists (figure 3). The bottom 70 percent of the population could gain up to 8 cents for each dollar of tax paid by the top 30 percent of the population.

The purpose in presenting this example is to demonstrate the importance of separating the tax instrument from the commodity. The same commodity could have different tax bases depending on the nature of the change in the tax function. A good example is motor vehicles. Many developing countries (including Indonesia) impose taxes on different properties, such as quantity (a constant amount per vehicle), weight, engine size, and, of course, value. The different taxes may have significant differences in their distributional characteristics, a property that can be exploited to increase the variety of tax instruments.
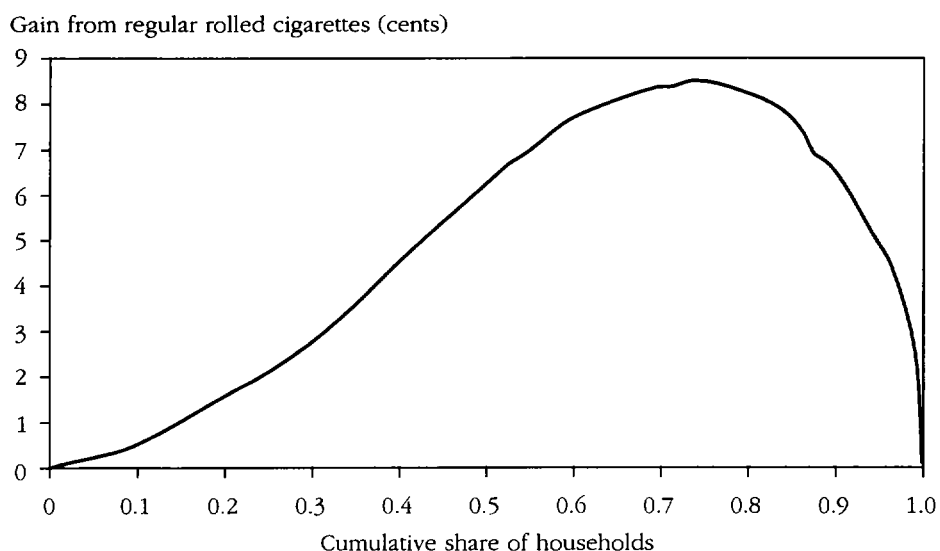
VII. DALTON-IMPROVING REFORMS INVOLVING MORE THAN ONE COMMODITY

In order to search for Dalton-improving reforms that involve more than one commodity, we need to determine the MECF of the commodities, which we cal-

9. To see this, note that $E = PQ$, where P is price and Q is quantity. Let Y be income. Then $\Delta E = P\Delta Q + Q\Delta P$. Hence:

$$\frac{\Delta E}{\Delta Y}\frac{E}{Y} = \frac{\Delta Q}{\Delta Y}\frac{Y}{Q} + \frac{\Delta P}{\Delta Y}\frac{Y}{P}.$$

Figure 3. *The Gain from a Combination of a Subsidy and a Tax, Indonesia*

Gain from regular rolled cigarettes (cents)

Cumulative share of households

Note: The figure plots the gain at each cumulative household share of a dollar of tax paid by the higher-income households above that level. Cumulative share of households is from the lowest- to the highest-income.

Source: Authors' calculations.

culate using the CGE model (table 2). If the tax planner cares only about efficiency, then the optimal policy is to equate the marginal efficiency costs of public funds. Comparing the income elasticities in table 1 with the MECFs in table 2, we see that the ranking of the two is equal, meaning that the structure of taxation of those commodities is reasonable in that a higher share of tax paid by the poor corresponds to a lower marginal excess burden. From this result we can conclude that the structure of Indonesian energy taxes does take into account distributional considerations.

The cost at the margin to society of raising a dollar of revenue from the gasoline tax is 2.7 dollars (figure 4). The burden on the poorest 50 percent of the

Table 2. *Parameters for Calculations of Marginal Efficiency Costs of Public Funds, Indonesia*

Variable	Tax base, X (billions of 1985 Indonesian rupiah)	Marginal revenue from tax, MR (billions of 1985 Indonesian rupiah)	Marginal efficiency costs of public funds, MECF	Initial tax rate
Kerosene	62.2	57.4	1.08	−0.48
Electricity	83.5	73.4	1.13	0.00
Gasoline	104.7	38.7	2.70	0.30

Source: Authors' calculations.

population is 12 cents, and the rest is borne by the wealthier half of the population. On the other hand, a dollar of revenue raised through a tax (reduction of the subsidy) on kerosene costs society only 1.08 dollar, but the poorest half of the population pays 40 cents. An economist guided by efficiency concerns would recommend that the subsidy to kerosene be reduced and the tax on gasoline lowered in order to reduce distortionary taxation. This measure would save society more than 1.5 dollars for each dollar reduction in the subsidy to kerosene. On the other hand, the economist who cares about distribution will point out that the burden of those taxes is not shared fairly. More of the burden of kerosene taxation is borne by the poor, so that a transfer of a dollar of taxation from gasoline to kerosene can be viewed as a transfer from the poor to the rich. This divergence between policy prescriptions based on efficiency alone and those based on equity alone confirms that the Indonesian taxes embody a reasonable tradeoff between objectives: although efficiency considerations call for reducing the gap in tax rates, distributional concerns point in the other direction.

Note that all curves in figure 4 intersect, meaning that it is impossible to find a Dalton-improving neutral tax reform that involves only two commodities. On the other hand, intersection points to the possibility of finding two different social welfare functions, both of which conform to the Dalton criterion. One function can justify raising the tax on one commodity and lowering the tax on the second, while the other function can show the opposite. The ability to find two social welfare functions that give contradicting recommendations means that it is impossible to find a Dalton-improving reform.

Figure 4. *Distributional Burden of Energy Taxes, Indonesia*

Cumulative burden of 1 U.S. dollar of tax (dollars)

Cumulative share of households
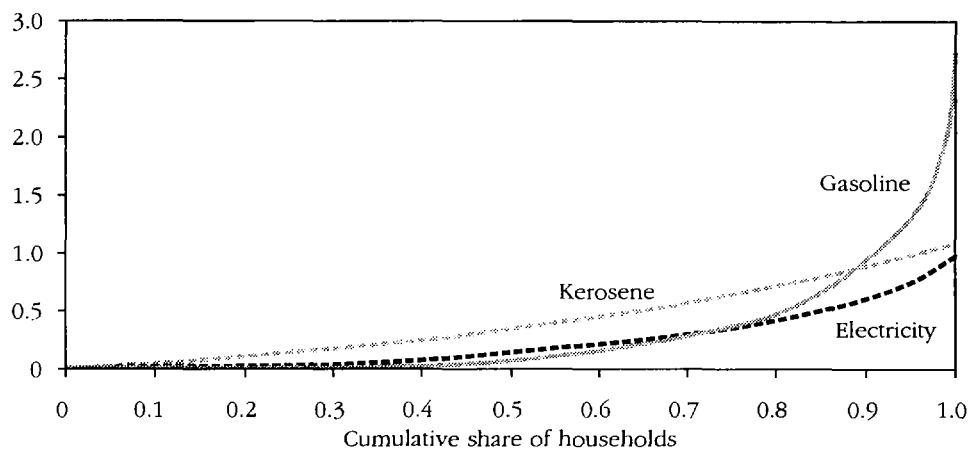
Note: Cumulative share of households is from the lowest- to the highest-income. Each curve is the concentration curve of the commodity multiplied by the marginal efficiency cost of public funds of that commodity.

Source: Authors' calculations.

Economists are neither equipped nor entitled to handle issues of fairness. In order to reach specific conclusions, social planners must be more specific with regard to their social preferences. We can say for certain only that the Indonesian taxation of the commodities we examined takes into account distributional concerns.

Having failed to find a Dalton-improving reform that is based on two commodities, we must search for a three-commodity reform. In this case, we have freedom to set only one tax: one tax change is used as a numeraire, so its value is either 1 or −1, and a second tax change is determined by the budget constraint. Since only one variable is free and the set of efficient Dalton-improving reforms is a cone, if a given set of Dalton-improving reforms is not empty, it forms a closed section on an interval.

Applying the optimization algorithm to this three-commodity question, we find that Dalton-improving, revenue-neutral reforms have the following structure: an increase in the tax on electricity and a decrease in the taxes (subsidies) on kerosene and gasoline (table 3). Reform D (distribution) says that each dollar reduction in the tax on kerosene is accompanied by a reduction in the tax on gasoline by 3.5 cents and an increase in the tax on electricity by 1.035 dollars. Reform E (efficiency) raises the tax on electricity by 3.26 dollars and reduces the tax on gasoline by 2.26 dollars for every 1 dollar reduction in the tax on kerosene. Any convex combination of those reforms is a Dalton-improving, revenue-neutral reform as well.

Reform D does not result in an efficiency gain to society, but it results in a gain to low-income groups (figure 5). To see the amount of efficiency gain, add up the products of the MECFs and the revenue changes (in table 3): $(1.0)(1.083) - (1.035)(1.13) + (0.035)(2.70) = 0.008$. Reform E results in an efficiency gain of 3.5 dollars for every dollar reduction in the tax on kerosene, but the gain is limited to high-income groups.

Now that we have identified a set of Dalton-improving reforms, we can consider the appropriate reform by introducing other considerations. Although the nature of these considerations can vary from one country to another, a few possibilities include the following:

- Dalton-improving reforms should not discriminate between regions or ethnic groups. The way to incorporate such a consideration is to impose the restriction that reforms must be Dalton-improving for each region or group.

Table 3. *Structure of Revenue-Neutral Dalton-Improving Reforms, Indonesia* (U.S. dollars)

Reform	Kerosene	Electricity[a]	Gasoline[a]
Distribution (D)	−1.0	1.035	−0.035
Efficiency (E)	−1.0	3.260	−2.260

a. The change in the tax on the commodity for each one-dollar reduction in the tax on kerosene.
Source: Authors' calculations.

Figure 5. *Cumulative Gain of Two Extreme Dalton-Improving Reforms, Indonesia*
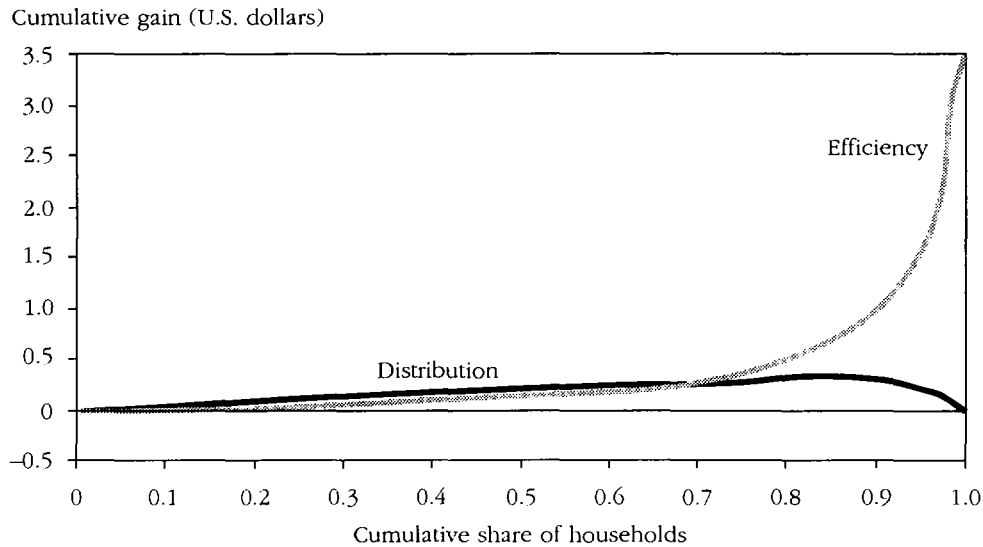
Cumulative gain (U.S. dollars)

Cumulative share of households

Note: Cumulative share of households is from the lowest- to the highest-income.
Source: Authors' calculations.

- The set of Dalton-improving reforms was derived under the assumption that expenditure per capita represents the ranking of economic well-being. Most economists will probably agree that family size can affect economic well-being, but there may be disagreement about its quantitative effect. The same argument can be raised with respect to a rural/urban distinction. Mayshar and Yitzhaki (forthcoming) show how to incorporate such considerations.

- An additional consideration is popular support. To satisfy both the economist and the politician we can, for example, search for Dalton-improving reforms that maximize the number of beneficiaries. The major problem in incorporating such a constraint is that, unlike the search for a Dalton-improving reform, which can be carried out with tabulated data, the search for a majority requires that the whole sample be examined. Needless to say, this constraint is much less binding in the era of modern computers.

VIII. SENSITIVITY ANALYSIS

Most of the analysis in this article was carried out without any parameterization: no assumptions were made on the curvature of the Engel curves of the

commodities, and the assumptions concerning the social welfare function are pretty mild. The only parameters that are derived from rigorous modeling efforts are the marginal efficiency costs of public funds. But revenue estimates are routinely performed by almost all treasury departments, and they are necessary inputs into the tax reform process. Because revenue estimates are based on a blend of complex modeling and intuition, performing traditional statistical testing is often difficult, especially if the number of parameters is large.

One way of investigating the robustness of our conclusions is to perform a sensitivity analysis on our revenue estimates by changing the marginal efficiency cost of public funds and observing the effect on the set of Dalton-improving reforms. Since our results depend only on the ratios of these costs, any multiplicative bias in the estimates should not affect the conclusions. Also, it is clear that if the marginal efficiency cost of public funds of kerosene is reduced and the costs of electricity and gasoline are increased, there will be no qualitative change in the conclusions.

Because of its magnitude, the marginal efficiency cost of public funds for gasoline (2.7) (see table 2) is most suspect. To evaluate how strongly it shapes the results, we reduced it gradually to see if our conclusions changed qualitatively. Small changes did not change the results qualitatively, and even a reduction by 40 percent (from 2.7 to 1.62) still produced a Dalton-improving reform (−1.0 for kerosene, −1.67 for gasoline, +2.66 for electricity) and an overall efficiency gain of 0.75 dollar (these results are not shown). Changing the marginal efficiency cost of public funds of electricity by 10 percent upward and downward also failed to produce any qualitative change.

An explanation for the robustness of the results can be found by reexamining figures 2 and 3. Figure 2 shows that if the marginal efficiency costs of public funds are equal, there can be three types of Dalton-improving reforms: subsidize kerosene and tax electricity, subsidize kerosene and tax gasoline, or subsidize electricity and tax gasoline. Hence, if the marginal efficiency cost of public funds of electricity is lower than that of kerosene, the Dalton-improving reform will consist of subsidizing kerosene and taxing electricity. Therefore the conclusion that we should increase the subsidy to kerosene will be unaffected even if the marginal efficiency costs of public funds of electricity and gasoline are lowered to equal that of kerosene. On the other hand, it is worthwhile to reduce the subsidy to gasoline because of its high marginal efficiency cost of public funds. This result will not be affected as long as this cost continues to be higher than that of electricity. If the marginal efficiency cost of public funds of gasoline is below that of electricity, then the Dalton-improving reform would call for an increase in the tax on gasoline and subsidizing electricity. But for this result to occur, the marginal efficiency cost of public funds for electricity must rise from 1.1 to above 2.7.

Finally, it should be noted that Dalton-improving reforms are not sensitive to the number of instruments considered. That is, provided that the estimates of the marginal efficiency cost of public funds are not affected, the reforms found

Table 4. *Nonneutral Dalton-Improving Reforms, Indonesia*
(U.S. dollars)

Reform	Revenue[a]	Kerosene	Electricity[b]	Gasoline[b]
Distribution, D.5	0.50	−1.0	1.91	−0.41
Efficiency, E.5	0.50	−1.0	2.88	−1.38
Successful reform, R.7S	0.70	−1.0	2.38	−0.68
Failed reform, R.75F	0.75	−1.0	2.56	−0.81

a. The revenue requirement of the reform. Values are for each one-dollar reduction in the tax on kerosene.

b. The change in the tax on the commodity for each one-dollar reduction in the tax on kerosene.

Source: Authors' calculations.

to be Dalton-improving will continue to be so even if we change additional taxes and subsidies. Additional instruments can only increase the Dalton-efficient set, they cannot eliminate a solution from the feasible set.

IX. NONNEUTRAL REFORMS

To analyze nonneutral reforms, we must know the public's willingness to pay for the public goods produced by the government. Since some of the Dalton-improving reforms brought about an efficiency gain, the question arises as to whether it is possible to split the gain between the public and the government, subject to the extreme and unrealistic assumption that the government "wastes" its share. To search for such a reform, we have to change the revenue constraint (equation 6) so that $dR \geq c$, where c is a constant greater than zero.

We consider four reforms (table 4). The first two reforms, D.5 and E.5, are the extreme Dalton-improving reforms, subject to the constraint that the reform must raise 50 cents on every dollar of subsidy to kerosene. Since kerosene is chosen to be the numeraire, the reforms are normalized according to its subsidy; however, as a result, each reform raises a different amount of tax revenue. Alternatively, the amount of additional taxes collected could be chosen as the numeraire, but in this case the numeraire would have to be adjusted after each calculation. Similar to the reforms reported in table 3, reform D.5 increases the income of the poor, and reform E.5 primarily increases efficiency. Comparing table 3 with table 4 reveals that the set of nonneutral Dalton-improving reforms that raise revenue by 50 cents to each dollar of subsidy is contained within the set of Dalton-improving reforms that are revenue neutral. The range of change in electricity taxation has declined from 1.035–3.26 dollars to 1.91–2.88 dollars, which may indicate that the distributionally oriented reforms are more sensitive to revenue neutrality than reforms concerned with efficiency.

Given the possibility of raising revenue and satisfying the Dalton criterion, we are tempted to ask how much more revenue can be extracted. From the last two rows of table 4, we see that when the revenue requirement was raised to 70 cents, we could still find Dalton-improving reforms. Reform R.7S reports the changes in taxes that are required. However, an attempt to raise 75 cents failed

Figure 6. *Cumulative Gain of Revenue-Raising Reforms, Indonesia*

Cumulative gain (cents)

Cumulative share of households
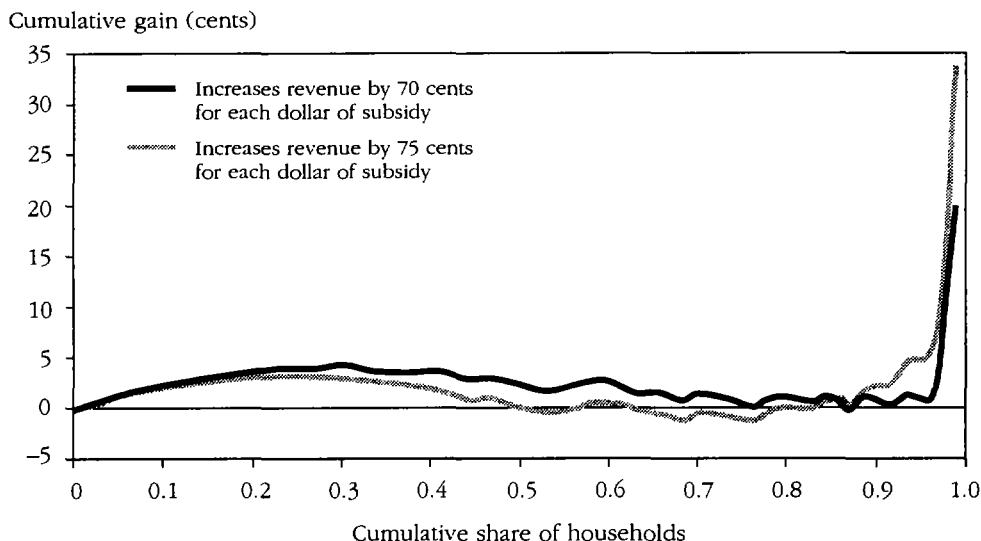
Note: The lines show the cumulative gains to the public for reforms raising $0.70 and $0.75 in revenue for each dollar of subsidy. Cumulative share of households is from the lowest- to the highest-income.

Source: Authors' calculations.

to find a Dalton-improving reform—reform R.75F is the best reform that could be found, although it is not a Dalton-improving reform. Examining the cumulative gains to the public (ignoring additional revenue) of reforms R.7S and R.75F (figure 6), we see that reform R.7S continues to generate a cumulative gain of 35 cents, mainly for the top three deciles, a gain of 5 cents for the lowest two deciles, and a loss of 5 cents to the middle class. Although reform R.75F does generate 75 cents, it hurts the second to the sixth deciles (the cumulative gain curve is declining), while the rich still receive 30 cents.

X. Further Research and Conclusions

The sensitivity analysis carried out suggests that the recommended directions for tax reform are robust with respect to variation in the marginal efficiency costs of public funds. The question is whether these recommendations are sensitive to other assumptions.

We could argue, for example, against aggregating rural and urban populations because of concerns that urban and rural economic welfare are not comparable—a higher income may be needed in the city for households to reach the same level of economic well-being as in rural areas—or transfers between urban areas and rural areas (or the reverse) cannot be made for political reasons. These

Table 5. *Gini Income Elasticities*

Variable	All	Urban	Rural
Kerosene	0.59	0.21	0.55
Electricity	1.61	1.12	1.37
Gasoline	2.30	1.90	2.62

Note: Income elasticity is calculated with respect to expenditure; households are ordered according to expenditure per capita.
Source: Authors' calculations.

two concerns can be handled by imposing additional constraints on the Dalton-improving reform (Mayshar and Yitzhaki forthcoming).

We can evaluate the sensitivity of our results to the aggregation of rural and urban households by calculating Gini income elasticities (table 5). There are significant differences in income elasticities (and hence in the shape of the Engel and concentration curves) between rural and urban populations. The overall income elasticity of kerosene and electricity is bigger than the income elasticity in either rural or urban areas, indicating that the Engel curve of the full population is steeper than the Engel curve for each subpopulation. However, the income elasticity of gasoline for the entire population falls between that for the urban and that for the rural. These elasticities suggest that the results can be affected by imposing a constraint on rural-to-urban cross-subsidization.

This article describes the search for Dalton-improving reforms. When the method is applied to the energy sector of Indonesia, which is characterized by high gasoline taxes and high kerosene subsidies, we find that efficiency concerns alone suggest that the distortionary gasoline tax and kerosene subsidy should both be lowered. But when distributional concerns are considered, we see that the given structure of energy taxes is more reasonable. Indeed, the analysis suggests that, given the structure of demand for different energy products, equity could be improved further by reducing the gasoline tax, increasing the subsidy to kerosene, and imposing a tax on electricity (to achieve revenue neutrality). These conclusions are robust to changes in the relevant parameters representing the Indonesian economy.

APPENDIX. THE COMPUTABLE GENERAL EQUILIBRIUM MODEL

The Indonesian CGE model used to derive the estimates of the marginal efficiency cost of public funds is one of a class of models that have been applied to issues of trade strategy, income distribution, and structural change in developing countries. Such models simulate the operation of a market system in which prices, wages, and the exchange rate vary in order to equate supply and demand for goods, labor, and foreign exchange. A variety of substitution mechanisms are specified among labor types, between capital and labor, between value added and intermediate inputs, between imports and domestic goods, and between

exports and domestic sales—all occurring in response to variations in relative prices.

The CGE model contains twenty-six productive sectors. The structure of the energy and environment sector includes seven separate fuel sectors (coal, diesel, fuel oil, gasoline, high-speed diesel oil, kerosene, and natural gas) and three others that are related to energy supply and demand (electricity and gas, lique-fied natural gas, and oil). Of the remaining sectors, two are agricultural, three are services, and the others are industrial. There are seven primary factors of production (two types of agricultural labor, three types of industrial labor, capi-tal, and land), four household categories, and three groups borrowing externally (the government, public enterprises, and the private sector), with separate ex-ternal debt accounts for each. Labor supply in each category is assumed to be fixed. Investment is set equal to total savings, determined by applying fixed saving rates to household and government income. In keeping with the focus on energy, we expanded the modeling of energy supply and demand interactions. The model includes the possibility of extensive interfuel substitution and speci-fication of more elaborate market-clearing mechanisms for the energy products in order to reflect the endogenous fuel taxes or subsidies created by the system of government-administered retail fuel prices.

Although there are a variety of different tax instruments in the model, the simulations carried out for this article involve changes only in the sectoral con-sumption tax levied on domestic consumption (including both domestically pro-duced and imported goods). In each case the experiment involves raising the sectoral tax by 5 percentage points from its initial value. The static revenue impact is calculated as 5 percent of the base-period value of consumption. The equilibrium impact is the overall change in government revenue after the model is solved and all markets clear following the tax change. Although estimates of revenue change depend on the parameterization of the CGE model, what is im-portant for the Dalton-improving calculations is the relative magnitudes of the marginal efficiency cost of public funds for each commodity. Given the CGE model structure, different plausible parameter choices are unlikely to affect the ranking or relative magnitudes of these costs.

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A New Development Data Base

The following article is the first in an occasional series introducing new data bases. The series intends to make new development data bases more widely available and to contribute to discussion and further research on economic development issues. The data bases included in the series are selected for their potential usefulness for research and policy analysis on critical issues in developing and transition economies. Some are drawn from micro-level firm or household surveys; others contain country-level data. The authors describe the data contents, criteria for inclusion or exclusion of values, sources, strengths and weaknesses, and any plans for maintenance or updating. Each data base is available from the author, at the address provided in the article.

A New Data Set Measuring Income Inequality

Klaus Deininger and Lyn Squire

This article presents a new data set on inequality in the distribution of income. The authors explain the criteria they applied in selecting data on Gini coefficients and on individual quintile groups' income shares. Comparison of the new data set with existing compilations reveals that the data assembled here represent an improvement in quality and a significant expansion in coverage, although differences in the definition of the underlying data might still affect intertemporal and international comparability. Based on this new data set, the authors do not find a systematic link between growth and changes in aggregate inequality. They do find a strong positive relationship between growth and reduction of poverty.

Following a long-standing recognition of potentially important relationships between economic growth and inequality, the profession has recently rediscovered the topic, emphasizing, in particular, the potential endogeneity of growth and interactions between the economic and political systems. Earlier discussions, such as the famous Kuznets Hypothesis, were framed mainly in terms of an exogenous growth process and its implications for inequality. In contrast, the recent literature has focused on the potential effects of inequality on growth in a wide variety of circumstances. Although attention has focused on both political and economic explanations for such a relationship, the underlying processes are still imperfectly understood. Indeed, theoretical models arrive at widely different conclusions, depending on the underlying assumptions. Which of these assumptions is more accurate is an empirical question that can only be decided by confronting the hypotheses emerging from such models with actual data.

Empirical work using cross-country data to draw inferences regarding the relationship between growth and inequality has a long tradition and has led to a number of fruitful (or controversial) hypotheses, including Kuznets's conjecture that inequality would increase with rising incomes at early stages of development and decrease at higher levels of per capita income. The lack of time series that are sufficiently long has prevented appropriate testing of these hypotheses. Furthermore, problems in the quality of data and the fact

that existing measures are often based on different definitions hamper comparability between countries—and often even within the same country over time—thus affecting empirical results in unpredictable ways. These concerns become more important as the complexity of theories about inequality and growth increases beyond the often simplistic mechanisms that characterized early models.

The main purpose of this article is to present a new data set on inequality and to discuss the procedures followed in putting it together as well as the remaining limitations. In section I we discuss our choice of the Gini coefficient, supplemented by income shares by quintiles, as the relevant distributional measure and set forth the criteria we applied in selecting data. In section II we describe the new data set and compare its coverage to existing compilations of data related to inequality. Compared with earlier data sets, our data represent a significant expansion in coverage and a substantial improvement in quality. That said, variation in the definition of the variables used to measure inequality—gross income or net income, income or expenditure, data per capita or data per household—can seriously affect the magnitude of the indicators of inequality and undermine the international and intertemporal comparability of the data. We therefore discuss how to deal with the problem of comparability in order to ensure the robustness of empirical analyses.

Section III turns from a description of how the data set was put together to an illustrative analysis of what it can tell us. Using both the Gini coefficient and share data, the data set describes regional and intertemporal differences in inequality, highlighting the familiar fact that inequality in Latin America is considerably higher than in the rest of the world. It also looks at the contemporaneous relationship between growth, inequality, and poverty. For the ninety-five growth spells for which we have information on income shares, we find no systematic link between growth and inequality, but we do find a strong positive relationship between growth and poverty reduction. In particular, growth benefits the poor in the vast majority (87.5 percent) of cases, whereas economic decline quite often hurts the poor disproportionately (in five out of seven cases). These findings illustrate the value of combining aggregate measures of inequality and information on income shares.

I. Methodological Issues

In assembling a data set on inequality, the distributional measure has to be chosen by weighing advantages and disadvantages. In addition, criteria have to be established to ensure that the data used do indeed measure the variable of interest with minimal error. Also, it is necessary to identify sources of residual variation remaining in the data—in this case differences in the definition of the variable being measured—and to assess the likely implications of such variation.

Measures of Inequality

This section does not attempt to substitute for a detailed discussion of different measures of inequality. Jenkins (1991) provides an overview and a more detailed discussion of these measures as well as a review of the literature. Our main purpose here is to justify our choice of variable—the Gini coefficient complemented by income shares of population quintiles wherever possible—as a way to combine maximum coverage of countries and time periods with an acceptable level of quality.

A popular representation of income inequality, the Gini coefficient is based on the Lorenz curve, which plots the share of population against the share of income received. We chose the Gini index as the indicator of inequality because it is widely reported in official sources that are based on primary data and because studies that included several measures, such as Anand and Kanbur (1993), found aggregate results to be similar for different measures of inequality.

One disadvantage of any aggregate measure of inequality such as the Gini index is that there is no unique mapping between changes in the index and the underlying income distribution; redistribution from the top to the middle class may be associated with the same change in the aggregate indicator as an increase in the share of income received by the bottom quintile at the expense of the middle class. To overcome this shortcoming, and to uncover possible movements in the income received by individual groups in society that could be obscured by the use of an aggregate measure such as the Gini index, we report information on income shares by quintile wherever possible. When our sources contained information on income shares that did not directly correspond to quintiles or when income shares but no Gini coefficients were reported, we used POVCAL, a statistical routine developed by Chen, Datt, and Ravallion (1995) to compute quintile shares or Gini coefficients, or both, based on the estimation of a parametric Lorenz curve. The POVCAL procedure fits a parametric Lorenz curve (general quadratic or beta) through the available distributional data. Where the estimated curve is valid, we use it to approximate the income shares obtained by different quintiles. To avoid making spurious inferences, we decided not to include cases in which the Lorenz curve thus estimated would have to be based on information for less than five income groups or cases in which there were obvious gaps in coverage. This procedure can be justified by noting that for a number of cases for which primary data were available, POVCAL produced estimates that were very close to the real distribution, even if based only on partial information.

Standards for Quality

Although a large number of earlier studies on inequality have amassed substantial data on inequality, the information included is often of dubious quality. Establishing a data set that allows cross-country comparison requires that minimum standards for quality be adopted. Slightly increasing the standards adopted

in the earlier literature (Fields 1989a), we require that observations be based on household surveys, on comprehensive coverage of the population, and on comprehensive coverage of income sources. In the following subsections we briefly discuss each of these requirements and their potential implications for measuring inequality. We also discuss the consequences of excluding specific observations reported in the literature. Different applications may call for different selection criteria, a concern that we hope to satisfy by making available all of the data reviewed.

HOUSEHOLD OR INDIVIDUAL AS UNIT OF OBSERVATION. We require that data on inequality be based on actual observation of individual units drawn from household surveys; we do not use data based on information from national accounts and some assumption regarding a general functional form according to which different types of income are distributed. The latter approach to measuring inequality relies on strong hypotheses about patterns of inequality across countries or over time that cannot be tested if such information is included in the data set. It is difficult to assess the error associated with such procedures because these procedures are normally used only when household surveys are unavailable, which means that a household-based control that would indicate the true value of inequality does not exist. Given that the reliability of these measures cannot be established, we exclude them from our data set.

Applying the criterion that the unit of observation be either the household or the individual, we exclude a number of studies such as Adelman and Morris (1973) and Van Ginneken and Park (1984). These studies have generated synthetic estimates of inequality from national accounts and assumptions on the functional form of the distribution of income taken from other countries "at the same level of development," from a social accounting matrix (SAM), or from extrapolation of the distribution of income observed in small surveys originating within the same country (Cromwell 1977 for Guatemala and Altimir 1986 for Argentina).

COMPREHENSIVE COVERAGE OF THE POPULATION. Use of a nonrepresentative subset of the population can easily result in biased estimates. Therefore, we require that data on inequality, even if drawn from household surveys, be based on a representative sample covering all of the population. Empirically, the most frequent deviations from this principle are surveys that cover only economically active individuals, wage earners, or taxpayers, or that cover only rural or urban dwellers.

Differences between Gini coefficients based on a subset of the population and those based on a nationally representative sample can be substantial. In Peru the expenditure-based Gini coefficient for metropolitan Lima in 1985 was 32, which was 10 points lower than the index obtained from a nationally representative sample (Government of Peru 1991). In South Africa, ex-

trapolation from detailed information only on whites resulted in an aggregate Gini index for 1987 of 48, 14 points below the one measured in a nationally representative household survey in 1993 (Lachman and Bercuson 1992; World Bank 1995).

Some analysts justify the use of observations from surveys that covered only a subset of the population by noting that it would be straightforward to determine the sign of the bias and, implicitly, that such a bias would be constant over time. For example, inequality among wage earners or the economically active population is generally higher than inequality among households that may contain more than one wage-earning member. Similarly, the observation that the distribution of income is more egalitarian in rural than in urban areas is the stylized fact at the heart of the Kuznets Hypothesis (Kuznets 1955; Anand and Kanbur 1993). Using observations from our data set, we can show that these generalizations are often violated. For example, in several countries, such as Côte d'Ivoire (Kozel 1990), Jordan (Haddad 1990), Tanzania (Ferreira 1994), Poland (Milanovic 1995), Sierra Leone (Kansal 1982), and, most strikingly, China (Chai and Chai 1994), contrary to conventional wisdom, rural incomes are distributed more unequally than urban ones.

There is not much theoretical or empirical justification to conclude that the difference between measures of inequality for various subgroups of the population will remain the same even within any given country (let alone across countries) because the underlying structural parameters change over time. The relationship between urban and rural inequality within the same country is far from static, as shown, for example, for India (Datt 1995) and Indonesia (Government of Indonesia, various issues). Therefore, it is not valid to draw inferences about national inequality from information on inequality within a subgroup of the population.

To avoid such errors, we discarded a large number of observations from Latin American countries—Argentina, Bolivia, Colombia, Ecuador, El Salvador, Paraguay, and Uruguay—where many household surveys have been limited to metropolitan or urban areas (Psacharopoulos and others 1992; Melgar 1989; Fishlow, Fiszbein, and Ramos 1993). Other countries for which we made a significant reduction in the number of included observations are Japan (Mizoguchi 1985), Israel (official surveys exclude the rural population), and Malawi and Madagascar (Pryor 1990).

COMPREHENSIVE MEASUREMENT OF INCOME OR EXPENDITURE. We require that measures of inequality be based on comprehensive coverage of different income sources as well as of population groups. We have two main concerns about noncomprehensive coverage.

First, the exclusion of nonmonetary income can impart serious biases to estimates of inequality, especially in developing countries. For example, nonmonetary items in Greece in 1974 accounted for more than 70 percent of the expen-

diture of the lowest decile, leading to considerable differences between a measure of income inequality based on full, compared with only monetary, expenditure (Government of Greece, various issues). We are aware that measuring nonmonetary income appropriately is difficult and that inflated figures concerning this component of income (in particular the imputed value of owned housing) can conjure up an image of a more egalitarian distribution of income than is actually the case. Given constraints on our resources, we were not able to pursue this issue further.

Second, measures of inequality reported in the literature are often based solely on wage income, thereby excluding nonwage earnings—pensions, for example, and income from self-employment. The reason is that the information underlying these studies has often been drawn from tax records, the population coverage of which differs widely (depending primarily on tax laws) and is generally far from comprehensive. Measuring inequality solely on the basis of wage income would have a quantitatively significant effect on measured levels of inequality, especially if individuals with no wage earnings are included. Calculation of inequality measures from household-level data in the Luxembourg Income Study (see Atkinson, Rainwater, and Smeeding 1995) indicates that Gini coefficients based on wage earnings (including households with no wage earnings) are 10 to 15 points higher than coefficients based on gross income. This general order of magnitude is confirmed by observations from the secondary literature, both for industrial and for developing countries. For example, using wage income to assess inequality in Sweden in 1976 resulted in a Gini index of 43.6, compared with one of 28.1 based on nationally representative data (see our data set).

Although restricting attention to certain subsets of the population will undoubtedly have a dramatic effect on measured *levels* of inequality, its impact on *changes* cannot be neglected either. An exogenous shock that leads to layoffs of workers would, for example, affect overall inequality between households in the population but could leave inequality among wage earners unaffected, in which case use of the latter would give a very distorted picture.

The principle of comprehensive coverage obliged us to exclude relatively long time series on inequality in Greece (Lianos and Prodomidis 1974), Morocco (Bourguignon and Morrisson 1989), New Zealand (Easton 1983), and Sweden (Spant 1980). Similarly, observations for Nigeria that include only cash income (Owosekun and Otigba 1976) were excluded.

The paucity of observations available to study distributional issues causes each individual data point generally to acquire considerable importance. For each of the three issues discussed earlier—the unit of observation, comprehensive coverage of the population, and comprehensive measurement of income or expenditure—we can find examples that illustrate that the conclusions of earlier studies may have been affected by data of inferior quality. The combination of data based on national account estimates for early peri-

ods with information based on household surveys for later periods can lead to the appearance of large decreases in inequality, as in Kenya (Bigsten 1986). Comparison of inequality estimates from rural areas for 1953–64 with nationally representative data for later years gives rise to the appearance of a segment of initially increasing inequality along the Kuznets curve in the Republic of Korea (Kwack 1990). Using data that cover only a truncated subset of the population, such as wage earners—or, as we shall see later, data that are not based on a consistent definition more generally—could lead to virtually any type of growth-inequality pattern, such as a strong Kuznets curve for Malaysia (Meesook 1975).

II. THE NEW DATA SET

In this section we present the data set assembled using the above principles and compare it with existing compilations of data on inequality. We also highlight problems arising from variation in the definition of the variable used to measure inequality that may affect the intertemporal and international comparability of the inequality estimates contained in our data set. We briefly discuss how to deal with the problem of comparability.

Sources

We assembled the largest possible set of Gini coefficients and other income distribution measures that were reported in the literature and that seemed to have national coverage. Doing so yielded more than 2,600 observations, characterized by great heterogeneity, with Gini coefficient estimates ranging from 12.1 (China 1982) to 79 (Zambia 1970). These data suffer from two problems. First, the documentation in secondary sources is often very weak or totally absent, thus forcing the reader to make guesses concerning coverage, definitions of income, or units of measurement. Second, a good proportion of Gini coefficients of very doubtful quality continue to be passed down from generation to generation (with each author quoting only the immediate predecessor) without satisfying minimum criteria for quality.

In view of these problems, it was necessary to go back to primary sources wherever possible to be able even to decide on the quality of an observation. In many cases the principles outlined in section I were useful as heuristic tools that allowed us to uncover and explain certain biases and irregularities in the Gini coefficients reported in the literature. Once we had identified a reputable source with the necessary information, we applied the three criteria outlined earlier to decide whether to include the observation in the high-quality data set (that is, the one that meets the three criteria). When more than one observation for the same year and country satisfied the minimum criteria, we used consistency of definition and source as well as origin in an official publication as criteria for inclusion. Given the large variation in data quality and reporting formats, con-

sistency of sources as well as levels of aggregation are important, even if primary sources are used.[1]

The procedures we followed resulted in a data set of 682 observations (for 108 countries), of which about 65 percent are based on primary sources such as national statistical agencies (50 percent) or compilations of such results by reputable international agencies (15 percent). The remaining 35 percent of the data are based on primary sources that have been quoted by a reliable secondary source. Table 1 provides summary statistics by region and economy—number of observations; mean, minimum, and maximum Gini coefficient; standard deviation; period covered; and the ratio of the top quintile's to the bottom quintile's share of income in cases for which share data are available. Both the high-quality data set with the respective definitions and the original, large data set with the reasons for rejecting certain observations are available from the Bank's Web server.[2]

Decisions concerning the inclusion or exclusion of certain observations are always based on some judgment and arbitrariness. Although we have attempted to be as objective as possible, we have undoubtedly either missed or misinterpreted a piece of available information in some cases. We hope that making available all the original data reviewed will allow interested readers to correct those lapses or to adapt the data to suit their more specific needs.

Coverage and Comparison with Existing Data Sets

We highlight some of the features of our data set by comparing it with the compilations by Jain (1975), Paukert (1973), and Fields (1989b), which have in various combinations been used by the existing literature on inequality and growth.[3] Such a comparison demonstrates three points. First, when the three criteria for quality are applied consistently to all the data sets, it is apparent that our data set contains a substantially larger number of high-quality observations than any of the others (see table 2, rows 1 and 2). With 682 high-quality observations, the new data set has nine times as many observations as the largest of the other data sets. Second, the new data set has a much greater coverage of economies—three times as many as the next largest data set (see table 2, row 3). Third, and perhaps most important for the study of the relationship between inequality and growth through time, our data set provides a more reliable basis

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1. The empirically most relevant case is that countries often report the share of households in different income groups. If income is in nominal terms, if the class boundaries stay constant over time, and if no average income (or expenditure) for individual groups is reported, the simple fact that there are fewer and fewer households in the lower brackets would give rise to the illusion of a decrease in inequality over time. We encountered this phenomenon for the Philippines (for which we switched to decile shares as a consequence), for Tunisia (for which we decided not to report shares but only the Gini coefficient provided in the government's statistical yearbook), and for Sweden. In the last case, adding the mean for the respective income groups (which is available in the government's statistical yearbook) changed the Gini coefficient by up to 4–5 points. We have tried to avoid using such data wherever possible.

2. The address is http://www.worldbank.org/html/prdmg/grwthweb/growth_t.htm

3. The data set by Paukert forms the basis for the data set in Lecaillon and others (1984).

for time-series analysis (see table 2, rows 4 and 5). Compared with an average of about two high-quality observations for each country in Fields and Jain, our data set contains an average of more than six high-quality observations for each country. It contains fifty-eight countries with four or more high-quality observations compared with only ten such countries in the next largest data set. Although we had to discard a number of observations from early periods because of their quality, expanded coverage in more recent periods has more than compensated for them.

Examination of the quality of the data suggests that a large number of data points used to substantiate the negative relationship between initial income inequality and subsequent growth in the literature may be of doubtful quality (Persson and Tabellini 1995; Alesina and Rodrik 1994). For example, the Persson and Tabellini data set, based on Paukert (1973), includes several countries (Burma, Chad, Cyprus, Benin, Iraq, and Lebanon) for which we were unable to locate data of acceptable quality. In addition, one-third of Persson and Tabellini's Gini coefficients differ by 5 or more points from the closest acceptable observation, and only eighteen of their fifty-five observations satisfy the criteria for quality indicated above. Although the data used by Alesina and Rodrik—at least the part based on Fields (1989b)—are of much higher quality, their data set still contains fourteen observations that differ by more than 5 points from the closest comparable value available in our data set. The negative relationship between income inequality and growth evaporates if, for example, we attempt to rerun the regressions by Persson and Tabellini using only the eighteen (out of fifty-five) high-quality observations contained in their sample.

The large number of observations in our data set enables us to better account for the time-series dimension of the data. This is important because making inferences on longitudinal relationships such as the Kuznets Hypothesis from cross-sectional data is questionable (Fields and Jakubson 1994; Ravallion and Chen 1995). Indeed, our data provide little support for an inverted-U relationship between levels of income and inequality when tested on a country-by-country basis, with no support for the existence of a Kuznets curve in about 90 percent of the countries investigated.

Despite the improvement over earlier data sets, coverage still varies widely across regions and decades. In particular, a comparison of the number of economies included in the data set by region reveals that Asia, Eastern Europe, and industrial and high-income economies are very well represented, whereas countries in the Middle East and North Africa, and especially Sub-Saharan Africa, are underrepresented (see table 3). And within economies, our coverage of Sub-Saharan Africa and the Middle East and North Africa is also thin, with fewer than two observations for each economy on average, compared with more than ten in Asia and the industrial economies. Table 3 reveals a significant improvement in the number of observations over time: there are twice as many observations for the 1980s as for the 1960s.

Table 1. *Descriptive Statistics and Coverage of the Data Set on Income Inequality, Selected Economies*

Region and economy	Number of observations	Average Gini	Minimum Gini	Maximum Gini	Standard deviation	First year	Last year	Ratio of top quintile's share of income to bottom quintile's share[a]
Sub-Saharan Africa	40	44.71	28.90	63.18	9.18	1968	1993	11.61
Botswana	1	54.21	54.21	54.21	—	1986	1986	16.36
Cameroon	1	49.00	49.00	49.00	—	1983	1983	—
Central African Republic	1	55.00	55.00	55.00	—	1992	1992	—
Côte d'Ivoire	4	39.18	36.89	41.21	1.86	1985	1988	7.17
Gabon	2	61.23	59.27	63.18	2.76	1975	1977	19.79
Ghana	4	35.13	33.91	36.74	1.42	1988	1992	5.97
Guinea-Bissau	1	56.12	56.12	56.12	—	1991	1991	28.57
Kenya	1	54.39	54.39	54.39	—	1992	1992	18.24
Lesotho	1	56.02	56.02	56.02	—	1987	1987	20.90
Madagascar	1	43.44	43.44	43.44	—	1990	1990	8.52
Mauritania	1	42.53	42.53	42.53	—	1988	1988	13.12
Mauritius	3	40.67	36.69	45.70	4.59	1980	1991	6.62
Niger	1	36.10	36.10	36.10	—	1992	1992	5.90
Nigeria	3	38.55	37.02	41.15	2.27	1986	1992	8.67
Rwanda	1	28.90	28.90	28.90	—	1983	1983	4.01
Senegal	1	54.12	54.12	54.12	—	1991	1991	16.75
Seychelles	2	46.50	46.00	47.00	0.71	1978	1984	—
Sierra Leone	1	60.79	60.79	60.79	—	1968	1968	22.45
South Africa	1	62.30	62.30	62.30	—	1992	1992	32.11
Sudan	1	38.72	38.72	38.72	—	1971	1971	5.58
Tanzania	3	40.37	38.10	44.00	3.18	1969	1993	6.63
Uganda	2	36.89	33.00	40.78	5.50	1989	1992	6.01
Zambia	2	47.26	43.51	51.00	5.30	1976	1991	12.11
Zimbabwe	1	56.83	56.83	56.83	—	1990	1990	15.66

East Asia and the Pacific	123	36.18	25.70	53.00	6.55	1953	1993	7.15
China	12	32.68	25.70	37.80	3.78	1980	1992	5.17
Fiji	1	42.50	42.50	42.50	—	1977	1977	—
Hong Kong	7	41.58	37.30	45.18	2.81	1971	1991	9.46
Indonesia	11	33.49	30.70	38.59	2.17	1964	1993	5.22
Japan	23	34.82	32.50	37.60	1.35	1962	1990	7.06
Korea, Rep. of	14	34.19	29.82	39.10	2.63	1953	1988	6.29
Lao PDR	1	30.40	30.40	30.40	—	1992	1992	4.21
Malaysia	6	50.36	48.00	53.00	1.96	1970	1989	14.18
Taiwan (China)	26	29.62	27.70	33.60	1.53	1964	1993	4.67
Philippines	7	47.62	45.00	51.32	2.46	1957	1991	12.00
Singapore	6	40.12	37.00	42.00	1.81	1973	1989	6.71
Thailand	8	45.48	41.28	51.50	3.78	1962	1992	11.65
Vietnam	1	35.71	35.71	35.71	—	1992	1992	5.51
South Asia	60	34.06	28.27	47.80	4.54	1951	1992	5.50
Bangladesh	10	34.51	28.27	39.00	3.52	1963	1992	5.72
India	31	32.55	29.17	37.05	2.06	1951	1992	4.98
Nepal	1	30.06	30.06	30.06	—	1984	1984	4.34
Pakistan	9	31.50	29.91	32.44	0.86	1969	1991	4.68
Sri Lanka	9	41.71	30.10	47.80	6.10	1953	1990	7.98
Eastern Europe	101	26.01	17.83	39.39	4.71	1958	1995	4.05
Armenia	1	39.39	39.39	39.39	—	1989	1989	23.88
Belarus	1	28.53	28.53	28.53	—	1995	1995	4.30
Bulgaria	28	23.30	17.83	34.42	3.40	1963	1993	3.24
Czechoslovakia	12	22.25	19.37	27.19	2.40	1958	1992	3.08
Czech Republic	2	27.43	26.60	28.26	1.17	1993	1994	3.75
Estonia	3	34.66	31.52	36.63	2.75	1992	1995	6.62
Hungary	9	24.65	20.97	32.24	3.57	1962	1993	3.61
Kazakstan	1	32.67	32.67	32.67	—	1993	1993	5.39
Kyrgyz Republic	1	35.32	35.32	35.32	—	1993	1993	6.31
Latvia	1	26.98	26.98	26.98	—	1993	1993	3.83
Lithuania	1	33.64	33.64	33.64	—	1993	1993	5.20
Moldova	1	34.43	34.43	34.43	—	1992	1992	6.06
Poland	17	25.69	20.88	33.06	2.52	1976	1993	3.75

Table 1. *(continued)*

Region and economy	Number of observations	Average Gini	Minimum Gini	Maximum Gini	Standard deviation	First year	Last year	Ratio of top quintile's share of income to bottom quintile's share[a]
Eastern Europe (continued)								
Romania	3	25.83	23.38	28.66	2.66	1989	1994	3.79
Slovak Republic	2	20.50	19.49	21.50	1.42	1992	1993	2.76
Slovenia	2	27.08	25.95	28.20	1.59	1992	1993	3.77
U.S.S.R.	5	26.94	24.56	30.53	2.32	1980	1993	4.06
Ukraine	1	25.71	25.71	25.71	—	1992	1992	3.71
Yugoslavia	10	32.62	31.18	34.73	1.00	1963	1990	5.63
Middle East and North Africa	20	40.77	32.00	45.45	3.07	1959	1991	7.14
Algeria	1	38.73	38.73	38.73	—	1988	1988	6.85
Egypt, Arab Rep. of	4	38.00	32.00	42.00	4.32	1959	1991	4.72
Iran, Islamic Rep. of	5	43.23	41.88	45.45	1.41	1969	1984	—
Jordan	3	39.19	36.10	40.80	2.67	1980	1991	7.39
Morocco	2	39.20	39.19	39.20	0.01	1984	1991	7.03
Tunisia	5	42.51	40.24	44.00	1.41	1965	1990	8.25
Latin America and the Caribbean	100	50.15	37.92	61.88	6.05	1950	1994	16.02
Barbados	2	47.18	45.49	48.86	2.38	1951	1979	17.56
Bolivia	1	42.04	42.04	42.04	—	1990	1990	8.58
Brazil	15	57.32	53.00	61.76	2.72	1960	1989	23.07
Chile	5	51.84	45.64	57.88	5.76	1968	1994	14.48
Colombia	7	51.51	46.00	54.50	2.68	1970	1991	13.94
Costa Rica	9	46.00	42.00	50.00	2.97	1961	1989	13.13
Dominican Republic	4	46.94	43.29	50.46	3.35	1976	1992	11.06
Ecuador	1	43.00	43.00	43.00	—	1992	1992	9.82
El Salvador	1	48.40	48.40	48.40	—	1977	1977	10.64
Guatemala	3	55.68	49.72	59.06	5.18	1979	1989	20.82
Guyana	2	48.19	40.22	56.16	11.27	1990	1990	9.15
Honduras	7	54.49	50.00	61.88	3.63	1968	1993	27.74
Jamaica	9	42.90	37.92	54.31	4.81	1958	1993	8.75

Mexico	9	53.85	50.00	57.90	3.09	1950	1992	17.12
Nicaragua	1	50.32	50.32	50.32	—	1990	1990	13.12
Panama	4	52.43	47.47	57.00	5.01	1970	1989	22.64
Peru	4	47.99	42.76	55.00	5.42	1971	1994	9.21
Puerto Rico	3	51.11	50.15	52.32	1.11	1969	1989	22.20
Trinidad	4	46.21	41.72	51.00	3.79	1958	1981	18.31
Venezuela	9	44.42	39.42	53.84	4.27	1971	1990	10.93
Industrial countries and high-income developing countries	238	33.19	22.90	56.00	5.76	1947	1993	6.63
Australia	9	37.88	32.02	41.72	3.08	1969	1990	8.32
Bahamas	11	45.77	40.64	54.09	4.10	1970	1993	14.14
Belgium	4	27.01	26.22	28.25	0.88	1979	1992	4.26
Canada	23	31.27	27.41	32.97	1.67	1951	1991	5.54
Denmark	4	32.09	30.99	33.20	1.26	1976	1992	6.29
Finland	12	29.93	26.11	32.04	2.17	1966	1991	5.35
France	7	43.11	34.85	49.00	6.07	1956	1984	6.31
Germany	7	31.22	28.13	33.57	1.71	1963	1984	5.35
Greece	3	34.53	33.29	35.19	1.07	1974	1988	6.37
Ireland	3	36.31	34.60	38.69	2.12	1973	1987	8.91
Italy	15	34.93	32.02	41.00	2.61	1974	1991	4.94
Luxembourg	1	27.13	27.13	27.13	—	1985	1985	4.11
Netherlands	12	28.59	26.66	29.68	0.95	1975	1991	4.43
New Zealand	12	34.36	30.04	40.21	2.90	1973	1990	6.78
Norway	9	34.21	30.57	37.52	2.90	1962	1991	7.39
Portugal	4	37.44	35.63	40.58	2.16	1973	1990	7.44
Spain	8	27.90	24.42	37.11	4.38	1965	1989	4.34
Sweden	15	31.63	27.31	33.41	1.49	1967	1992	5.64
Turkey	3	50.36	44.09	56.00	5.98	1968	1987	15.22
United Kingdom	31	25.98	22.90	32.40	2.61	1961	1991	4.03
United States	45	35.28	33.50	38.16	1.29	1947	1991	8.46
Total	682	36.12	17.83	63.18	9.33	1947	1995	7.80

— Not available.

a. This ratio is the average for all observations included in the data set.

Source: Authors' calculations based on various sources as described in the text.

Table 2. *Characteristics of Various Data Sets on Income Inequality*

Characteristic	Our data	Fields (1989b)	Jain (1975)	Paukert (1973)
Original number of observations	2,621	105	405	55
High-quality observations	682	73	61	18
Number of economies	108	36	30	18
Average number of high-quality observations per economy	6.31	2.03	2.03	1.00
Economies with four or more high-quality observations	58	10	8	0

Note: High-quality observations meet the three criteria described in the text.

Variation in the Definition of Variables

Even if indexes of inequality satisfy the criteria for quality outlined above, the indexes may not be fully comparable over time or across countries because of differences in how variables are defined. Here we explore the quantitative importance of differences in definition and discuss the pros and cons of options to increase intertemporal and interspatial comparability of data that are based on different definitions. The three main differences in definition we deal with are choice of the recipient unit, use of gross income or net income, and use of expenditure or income.

How a variable is defined is important for two reasons. First, if inequality changes only slowly over time and if different measurement concepts are in some cases associated with comparatively large jumps in Gini coefficients, the variation caused by changes related to definition could well account for most of the variation that is subsequently "explained" by conventional regression analysis. Basing measures of inequality within countries on identical measurement concepts would be crucial to reducing the potential for such error. Second, definitional issues might affect international comparisons of inequality, especially if the method of measurement varies systematically between different types of countries. One obvious source of such bias would be that more recent data on inequality, particularly for developing countries, are often measured in terms of expenditure rather than income, which would decrease measured Gini coefficients, other things being equal.[4] To avoid spurious correlations in both respects, researchers must seek ways to increase the comparability of inequality measures across time or countries.

RECIPIENT UNIT: THE HOUSEHOLD OR THE INDIVIDUAL? The distinction between households and individuals is important if there are systematic differences in

4. The countries for which the majority of Gini indexes in our data set are based on expenditure information are Algeria, Bolivia, Botswana, Cameroon, the Central African Republic, Côte d'Ivoire, Ecuador, the Arab Republic of Egypt, Estonia, Ghana, Greece, Guinea-Bissau, India, Indonesia, the Islamic Republic of Iran, Jamaica, Jordan, Kenya, Lao PDR, Lesotho, Madagascar, Mauritania, Mauritius, Morocco, Nicaragua, Niger, Nigeria, Pakistan, Peru, Portugal, Rwanda, Senegal, Spain, Sri Lanka, Tanzania, Tunisia, Uganda, Vietnam, and Zimbabwe.

Table 3. *Number of Economies and Observations Included in the Data Set, by Decade and Region*

| | Total | | 1960s | | 1970s | | 1980s | | 1990s | |
Region	Econ-omies	Obser-vations	Econ-omies	Obser-vations	Econ-omies	Obser-vations	Econ-omies	Obser-vations	Econ-omies	Obser-vations
Sub-Saharan Africa	24	40	2	2	5	6	11	16	14	16
East Asia and the Pacific	13	123	6	24	10	37	10	46	9	16
South Asia	5	60	4	24	4	13	5	17	4	6
Eastern Europe	19	101	4	9	5	21	8	39	18	32
Middle East and North Africa	6	20	3	4	3	5	5	7	4	4
Latin America and the Caribbean	20	100	9	12	15	34	14	35	12	19
Industrial countries and high-income developing countries	21	238	11	50	20	68	21	99	14	21
Total	108	682	39	125	62	184	74	259	75	114

Source: Authors' calculations based on various sources as described in the text.

size between rich and poor households. If, for example, the number of individuals per household is much higher in poor than in rich families, use of household-based data would result in a lower measure of inequality than measurement on a per capita basis. If, however, the difference is primarily caused by the number of children, simply dividing total household income by the number of people may in turn result in an overestimation of inequality. An adjustment based on adult-equivalents, rather than the number of individuals in the household, would be appropriate. Because multiperson households usually have greater possibilities for making intertemporal or interpersonal adjustments in labor supply and spending patterns than individuals do, systematic differences in household sizes may affect measured inequality in other ways as well.

Our data confirm that using the distribution of income across households rather than persons as the basis for the Gini index results in a slightly lower value of the index. In sixty-seven cases (included in the original data set) in which information on both households and individuals is available from reasonably reputable sources, the mean difference between person-based and household-based Gini coefficients is 1.69, with the household-based Gini indeed being lower in fifty of the sixty-seven cases. Given that the difference is not too large, we conclude that there is no reason to expect a large systematic bias in empirical work as a result of using both household-based and individual-based Gini coefficients.[5] We have therefore accepted measures of inequality based on either definition.

INCOME: GROSS OR NET OF TAXES? If, as in most industrial countries, taxation redistributes resources from the rich to the poor, use of gross income should yield higher measured inequality than use of net income. For Sweden (1981), for example, use of gross income yields a Gini coefficient that is about 5 points higher (39 compared with 34) than the Gini coefficient based on net income (the government's statistical yearbook). In a sample of nineteen pairs of Gini coefficients computed using Luxembourg Income Study (LIS) data, those based on net income were on average 3 points lower than those based on gross income, a difference that varied between 1.87 and 5.66. However, the LIS sample includes only one developing country (Mexico). Thus, although the distinction between gross income and net income may affect the level of measured inequality in a cross-country sample, the quantitative importance of this effect will depend on the progressivity and effectiveness of the tax system and might therefore be of less relevance for developing countries to the degree that the role of redistributive taxation is smaller in these countries.

VARIABLE MEASURED: INCOME OR EXPENDITURE? It is usually much easier for individuals to accumulate assets and savings to smooth consumption, that is,

5. This conclusion is supported by Coulter, Cowell, and Jenkins (1992) and Jenkins and Cowell (1994), who demonstrate that, for parametric variation of the equivalence scale between households and individuals, the Gini moves in a U-shaped fashion, with the difference between household- and per capita-based data not being too large.

expenditure, than to buy insurance against sickness or unemployment to smooth income. The greater variability of income resulting from this fact may be augmented by fluctuations in income (but not expenditure) associated with voluntary unemployment or by underreporting. Therefore, in a cross-section of individuals, using income as the measure would generally be expected to result in a higher degree of measured inequality than using expenditure. The tendency toward this result might be reinforced by the fact that expenditure is, by definition, based on net income, which, because of the progressivity of the tax system, tends to be more equally distributed than gross income.

Indeed, our data suggest a significant and systematic difference between income-based and expenditure-based coefficients. For the forty-seven observations of acceptable quality included in our data, the mean difference between expenditure-based Gini coefficients and those based on gross income is 6.6, ranging from −3 (for Bangladesh in 1973, the only negative value in the sample) to 20 (for Tanzania in 1969). It seems that some of the large intertemporal changes in our high-quality Gini indexes might be caused by shifts in definition rather than real changes in inequality. For example, in Peru, a 13-point drop in the Gini index between 1971 and 1986 can at least partly be explained by the change from income to expenditure as the relevant measurement concept. A similar situation arises with Jamaica, which had a 10-point drop in the Gini index between 1958 and 1971.

Ensuring Intertemporal and International Comparability

Given the important quantitative effects of definitional differences in the variables on which measures of inequality are based, it is important to account for such differences in any empirical application. Within any given country this is not too difficult, implying that one of the major advantages of our data set is that it permits a consistent assessment of intertemporal changes in inequality within countries. Because most countries change the methodology of their household surveys very infrequently, it is possible to obtain a consistently defined series within countries by eliminating only 10 observations from the original high-quality data set of 682 observations.[6] Therefore, we can look at changes in the Gini coefficient as well as in the shares and real income received by different quintiles within countries.

Methodologically, the most justifiable way to ensure cross-country comparability of inequality measures is to use only measures that are defined consistently. The quantitatively most important distinction arises from the difference between Gini coefficients that are based on information on income and those based on information on expenditures. Unfortunately, accounting for this difference would result in a considerably reduced sample—only 69 out of the original 108 countries or 546 income-based, compared with 682 total, observations (see table 4). Finding an appropriate way of adjusting observations to a com-

6. These observations are Bangladesh for 1989 and 1992, Brazil for 1974, Guyana for 1956, Jamaica for 1958, Mexico for 1992, Peru for 1971 and 1981, Seychelles for 1978, and Sri Lanka for 1990.

mon denominator would greatly increase the potential for making cross-country inferences.

We have seen above that, for identical surveys, the mean difference between income-based and expenditure-based Gini coefficients is about 6.6. This difference suggests that conclusions from a cross-country sample of Gini coefficients that includes both types of data may be misleading. One way of avoiding the exclusion of the thirty-nine countries for which Gini coefficients are based on expenditures would be to add the difference of 6.6 between expenditure-based and income-based coefficients to the 136 expenditure-based Gini coefficients in the sample. Such an adjustment would be supported by the fact that the difference between income- and expenditure-based Gini coefficients for the forty-seven available observations does not seem to follow any distinguishable pattern except for narrowing over time. Thus, the difference is not significantly correlated at the 5 percent level with levels of per capita income, continent dummies, or the average level of the Gini in the country, but it is correlated negatively (with a correlation of 0.47) with time. Given the importance of definitional differences, researchers should then explore the robustness of results that rely on cross-national comparisons to changes in definitions. In particular, it would be prudent to examine whether such results hold for (a) the raw data, (b) data that have been adjusted for differences between expenditure-based and income-based coefficients, and (c) data consistently based on a common definition.

A similar problem of cross-country comparability emerges for income shares and, in principle, should be handled in the same way. Thus, the robustness of any empirical results using the raw data should be checked against a sample of observations based on consistently defined income shares. Unfortunately, the number of observations in our sample for which share data on both income and expenditure are available is limited, making it difficult to arrive at any reasonable adjustment. Here we simply report the differences for the fifteen observations for which such information is available. We find that expenditure-based share data are on average 1.2 percentage points higher than income-based share data for the bottom two quintiles, close to 0 percentage points higher for the middle class (third and fourth quintiles), and 1.3 percentage points lower for the top quintile. The difference between expenditure-based and income-based share

Table 4. *Distribution of Observations by Inequality Measure*

Unit of observation	Income	Expenditure	Total
Household	345	25	370
Individual	201	111	312
Total	546	136	682

Note: Values are the number of observations in the data set that are Gini coefficients based on information on income and those based on information on expenditures. The sample includes 108 economies.

Source: Authors' calculations based on various sources as described in the text.

data ranges from −1.1 to 2.3 and −3.4 to 4.8 for the two bottom quintiles, −4.1 to 2.7 for the third and fourth quintiles, and −5.9 to 7 for the top quintile.

III. SOME DESCRIPTIVE EVIDENCE

Our data set can be used to revisit many of the relationships among growth, inequality, and poverty that have been studied in the literature. We undertake such an analysis in a separate paper (Deininger and Squire 1996). Here we use our data set to illustrate intertemporal and interregional differences in inequality and to provide an exploratory descriptive assessment of the relationship between growth, inequality, and poverty defined on the basis of income received by the bottom quintile. We highlight, among other points, how share data can usefully complement the one-dimensional Gini index of income inequality. We also explore the relationship between aggregate growth and changes in real income received by different quintile groups in the population. A similar exercise has been undertaken by Ravallion and Chen (1995), who focus on poverty defined as percentage of the population receiving less than a certain percentage of the mean. Ravallion and Chen concentrate on growth spells observed during the 1980s for forty-two developing countries. Given the large number of observations from Eastern European countries included, together with the relatively atypical performance of this group during the period concerned, the results of the study depend heavily on sample composition but, in general, do not contradict the findings reported here.

Regional Differences in Inequality

Decadal averages of inequality indexes across regions are presented in table 5. The regional averages are unweighted means of country averages during the period under concern. We have used raw data (that is, unadjusted data) and note that the composition of each regional sample can change over the four decades. The measures are relatively stable through time, but they differ substantially across regions, a result that emerges for individual countries as well (Li, Squire, and Zou 1996). The average standard deviation within countries (in a sample of countries for which at least four observations are available) is 2.79, compared with a standard deviation for the country-specific means of 9.15. We distinguish between three groups of regions, with considerable variation of Gini coefficients within regions:

- *Latin America and the Caribbean and Sub-Saharan Africa.* Inequality is highest in Latin America and Sub-Saharan Africa, where the simple average of country-level Gini coefficients is almost 50, ranging from 57 in Brazil to 42 in Bolivia. None of the Latin American countries has an average Gini coefficient below 40, in contrast to Sub-Saharan Africa, where the range is from 28.9 in Rwanda to 62.3 in South Africa. Gini coefficients for the countries in the Middle East and North Africa region are in the 40s, although

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the fact that most of the coefficients are based on expenditure rather than income may imply that they somewhat understate actual income inequality.

- *East Asia and South Asia.* East Asia and South Asia are characterized by average Gini coefficients in the middle to upper 30s that range from a high of about 50 in Malaysia and the Philippines to less than 30 in Taiwan (China). Gini coefficients are based on income for all economies except India.

- *Industrial and high-income developing countries.* Gini coefficients in the low 30s characterize the industrial and high-income developing economies. Although inequality in several industrial countries (including the United Kingdom and the United States) increased during the 1990s, this increase was compensated for by a decrease in inequality in countries such as Canada and Finland and by a relatively constant distribution of income in the Netherlands and Sweden. The historically low levels of Eastern Europe, a region that, with Gini coefficients in the mid-20s, is much more egalitarian than the rest of the world, show a considerable increase in the 1990s. For many of these countries (including the Russian Federation), Gini coefficients now stand in the lower 30s, comparable to those of some of the industrial countries.

Shares of total income received by different quintiles, possibly a more tangible indicator of inequality, are given in table 6. Although the aggregate picture is similar to the one conveyed by Gini coefficients, the share of income received by specific quintiles is not always completely congruent with the Gini coefficient, even at the regional level. For example, despite similar Gini coefficients in both regions, the top and bottom quintiles receive a higher share of total income in South Asia than in industrial countries. Despite a lower Gini coefficient than in Eastern Europe, the middle class in industrial countries receives a greater share and the top quintile a lower share than in Eastern Europe.

Table 5. *Decadal Averages of Inequality Indexes, by Region*

| Region | Gini coefficients | | | | |
	Overall average	1960s	1970s	1980s	1990s
Latin America and the Caribbean	49.78	53.24	49.06	49.75	49.31
Sub-Saharan Africa	46.05	49.90	48.19	43.46	46.95
Middle East and North Africa	40.49	41.39	41.93	40.45	38.03
East Asia and the Pacific	38.75	37.43	39.88	38.70	38.09
South Asia	35.08	36.23	33.95	35.01	31.88
Industrial countries and high-income developing countries	34.31	35.03	34.76	33.23	33.75
Eastern Europe	26.57	25.09	24.63	25.01	28.94

Note: Figures reported are unweighted averages of Gini coefficients of economies in each region. The sample includes 108 economies. Changes within regions may be caused by the fact that not all economies have observations for all decades.

Source: Authors' calculations based on various sources as described in the text.

Table 6. *Income Shares of Different Quintiles, by Decade and Region*

Quintile and region	Overall average	1960s	1970s	1980s	1990s
Lowest quintile					
Sub-Saharan Africa	5.26	2.76	5.10	5.70	5.15
East Asia and the Pacific	6.34	6.44	6.00	6.27	6.84
South Asia	7.74	7.39	7.84	7.91	8.76
Eastern Europe	9.34	9.67	9.76	9.81	8.83
Middle East and North Africa	6.66	5.70	—	6.64	6.90
Latin America and the Caribbean	3.86	3.42	3.69	3.67	4.52
Industrial countries and high-					
income developing countries	6.42	6.42	6.31	6.68	6.26
Middle class (third and fourth quintiles)					
Sub-Saharan Africa	34.06	32.72	32.15	35.40	33.54
East Asia and the Pacific	37.02	36.29	36.88	37.18	37.53
South Asia	37.25	37.05	37.89	37.17	38.42
Eastern Europe	40.65	39.69	41.59	41.25	40.01
Middle East and North Africa	36.28	35.30	—	35.88	36.84
Latin America and the Caribbean	33.21	28.13	34.59	33.58	33.84
Industrial countries and high-					
income developing countries	40.99	39.89	40.61	41.21	41.80
Top quintile					
Sub-Saharan Africa	51.79	61.97	55.82	48.86	52.37
East Asia and the Pacific	45.73	45.90	46.50	45.51	44.33
South Asia	43.01	44.05	42.19	42.57	39.91
Eastern Europe	36.11	36.30	34.51	34.64	37.80
Middle East and North Africa	46.32	49.00	—	46.72	45.35
Latin America and the Caribbean	55.12	61.62	54.18	54.86	52.94
Industrial countries and high-					
income developing countries	40.42	41.22	41.11	39.89	39.79

— Not available.

Source: Authors' calculations based on various sources as described in the text.

It has long been known that, in the presence of intersecting Lorenz curves, movements of the Gini coefficient may not accurately indicate changes in the welfare of individual groups in a population. Our data suggest that intersecting Lorenz curves are indeed observed in most cases (55 percent of the countries). This observation would imply that, within countries, there may be considerable changes in the income shares received by individual quintile groups of the population, despite the apparent stability of the Gini coefficient. By contrast, large differences in the Gini coefficient across countries need not necessarily be accompanied by an equally large variation in the shares of individual income groups.

Within countries, we do indeed find that changes in the aggregate Gini index and changes in the income shares of individual income groups are not very highly correlated, especially for the subsample of countries with intersecting Lorenz curves. Simple correlation coefficients for this subsample range from −0.3 for

changes in the share of the bottom 20 and 40 percent to 0.2 for the top 20 percent. The correlation is insignificant for changes in the shares of the third and fourth quintiles. The corresponding correlation coefficients for the complete sample are -0.53 between the change in the Gini coefficient and income growth for the bottom 20 and 40 percent, -0.26 between changes in the Gini and changes in the shares of the third and fourth quintiles, and 0.48 between changes in the Gini and changes in the share of the top quintile of income receivers.

Changes of similar magnitude in the income share of any given quintile could be associated with quite significantly different changes in the aggregate Gini coefficient. To illustrate, we compare two cases in which the share of the bottom quintile declined by about 4 percentage points. In Indonesia the decline occurred between 1978 and 1980 and was accompanied by a significant increase in the shares of the second to fourth quintiles and a decrease in the share of the top quintile, resulting in a net decrease of the Gini coefficient by about 3 points. In Hong Kong, a similar decline occurred between 1986 and 1991, but in this case the shares of both the third and the fourth quintiles increased, resulting in an increase in the Gini coefficient of 1.4 points.

Across countries, the intersection of Lorenz curves in pairwise comparisons is a frequent occurrence. As a consequence, large differences in Gini coefficients can be associated with income shares for individual population groups that are remarkably similar. Countries in which Gini coefficients differ by as much as 10 or more points may have almost identical shares of income for the bottom quintile. For example, the Gini coefficient in Korea in 1985 was 35.5, compared with 50 in Colombia in 1970. The bottom quintile received almost 7 percent of total income in both cases.

We conclude that, because Lorenz curves are observed to cross frequently, Gini coefficients and income shares can usefully complement each other in many types of analysis. To account for this we have included the ratio of incomes received by the top and bottom quintiles in table 1 and refer the reader to the data diskette for more details.

Growth, Inequality, and Poverty

The question of whether, or under what conditions, growth is associated with changes in inequality has intrigued economists for a long time. For all but a few countries for which long-enough time series have been available, for example, India, a satisfactory treatment of this issue has been precluded by a lack of sufficient country-level data and the fact that cross-sectional studies might pick up unobservable country-specific effects. Our data can be used to eliminate time-invariant country effects and to investigate the relationship between growth rates of aggregate income and inequality as measured by the Gini index. In addition, we can use the information on changes in individual quintiles' shares of total income together with information on aggregate growth to investigate changes in the real income received by different quintile groups and in particular the bottom 20 percent in the population. Real income is obtained by multi-

Table 7. *Growth, Inequality, and Poverty*

Indicator	Periods of growth (88)		Periods of decline (7)	
	Improved	*Worsened*	*Improved*	*Worsened*
Inequality	45	43	2	5
Income of the poor[a]	77	11	2	5

Note: "Improved" in the income distribution implies a decrease of the Gini coefficient; "worsened" implies an increase. The sample includes ninety-five economies.

a. The income of the lowest quintile.

Source: Authors' calculations based on various sources as described in the text.

plying the share of each quintile with real national per capita income (purchasing-power parity estimates, obtained from the Summers-Heston 1991 data set). Here we provide a descriptive analysis of these relationships.

We focus on the relation between changes in overall income and inequality during decadal growth episodes that are defined by the availability of distributional data that span at least one decade. The results illustrate two points (see table 7). First, there appears to be little systematic relationship between growth and changes in aggregate inequality. Periods of aggregate growth were associated with an increase in inequality almost as often (forty-three cases) as with a decrease in inequality (forty-five cases). Similarly, periods of economic decline were associated with increased inequality in five cases and with a more equitable distribution of income in two cases. The simple correlation between contemporaneous as well as lagged income growth and the change in the Gini coefficient is insignificant for the whole sample as well as for subsamples defined in terms of country characteristics (rich or poor, equal or unequal, fast-growing or slow-growing economies), suggesting no strong relationship between growth and changes in aggregate inequality.

The main reason for the lack of relationship appears to be that, whether average incomes are increasing or declining, changes in the Gini coefficient of inequality tend to be small (see Li, Squire, and Zou 1996). Thus, the average annual percentage change in the Gini coefficients in our sample was only 0.28 points, compared with an average growth rate in per capita income of 2.16 percent. Some examples illustrate the quantitative significance of this point. In Taiwan (China), real income per capita increased fivefold, from US$1,540 in 1964 to US$8,063 in 1990, whereas the Gini index barely changed, declining from 32.2 to 30.1. Similar outcomes can be observed in other economies: In the United States, real income increased from US$8,772 in 1950 to US$17,594 in 1991, yet the Gini index changed hardly at all, moving from 36.0 to 37.9. Brazil saw real income increase from US$1,784 in 1960 to US$4,271 in 1989 while the Gini index moved from 53.0 to 59.6. Even where inequality changed considerably, as in Thailand, where the Gini index moved from 41.3 in 1962 to 51.5 in 1991, the change in the index seems small compared with the fourfold increase in real income. This lack of change suggests that efforts to find systematic links between inequality and aggregate growth may have to be rethought (see Deininger and Squire 1996).

The second point is that changes in the absolute income received by different quintiles reveal additional information that is not captured in our aggregate measure of inequality. In particular, although we do not find significant correlations between aggregate growth and changes in inequality, there is a strong correlation between aggregate growth and changes in the income of all quintiles except the top one. Changes in absolute income enable us to investigate to what degree growth would be impoverishing, that is, to what degree increases in mean income would be associated with a fall in the income of the poor. We find that for most of the growth episodes in our sample, growth of average income, even if accompanied by increases in inequality, led to an increase in incomes for the members of the lowest quintile (see table 7). Aggregate growth was associated with an increase in the incomes of the poorest quintile in more than 85 percent of the ninety-one cases.

Nonconforming growth episodes are ones in which either the economy grew and the income of the poor decreased or the economy declined and the poor benefited. A case-by-case review of the thirteen nonconforming growth episodes confirms the strong association between aggregate growth and improvements in income for all groups of the population. In nine of the thirteen cases, the association can be shown to be caused by the use of ten-year growth spells; the association disappears when longer periods are considered. In three of the remaining four cases, aggregate growth was low—below 2 percentage points. This leaves only one case, Colombia from 1970 to 1980, where a growth rate of slightly more than 2 percent was associated with a slight decrease (0.9 percent) in the income of the poor. Thus, there is not a very strong basis on which to question the generally positive association between growth and the welfare of the bottom quintile.

To sum up, our data suggest no systematic relationship between growth of aggregate income and changes in inequality as measured by the Gini coefficient. The data do, however, suggest that a mere focus on distribution that neglects the large cross-country differences in overall growth may lead to flawed conclusions. Especially because changes in inequality tend to be relatively modest, we find a strong link between overall growth and a reduction in poverty. This link supports the hypothesis that economic growth benefits the poor in the large majority of cases, whereas economic decline generally hurts the poor.

IV. CONCLUSION

This article originated in an attempt to provide a data set on inequality that could narrow the gap between the far-reaching implications of the theoretical literature on inequality and the much more limited empirical evidence available to actually support and test such theories. To that end, we have expanded the available information on inequality. In our view, we have been more successful in improving the within-country, time-series dimension of the data, a significant improvement given that the evolution of inequality is inherently an intertemporal

issue. At the same time, we have identified a number of factors that are likely to affect cross-country research. We therefore caution researchers who use these data to interpret results carefully in light of the issues discussed here, to subject them to sensitivity analysis and tests for robustness, and to complement analysis based on summary statistics (such as the Gini coefficient) with data on income shares.

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