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Design: Luisa Menjivar-Macdonald and Sanaa Elaroussi
Threshold Effects in the Relationship Between Inflation and Growth

MOHSIN S. KHAN and ABDELHAK S. SENHADJI

This paper re-examines the issue of the existence of threshold effects in the relationship between inflation and growth, using new econometric techniques that provide appropriate procedures for estimation and inference. The threshold level of inflation above which inflation significantly slows growth is estimated at 1–3 percent for industrial countries and 11–12 percent for developing countries. The negative and significant relationship between inflation and growth, for inflation rates above the threshold level, is quite robust with respect to the estimation method, perturbations in the location of the threshold level, the exclusion of high-inflation observations, data frequency, and alternative specifications. [JEL E31, 040]

High and sustained output growth in conjunction with low inflation is the central objective of macroeconomic policy. Not surprisingly, the question of the existence and nature of the link between inflation and growth has been the subject of considerable interest and debate. Although the debate about the precise relationship between these two variables is still open, the intensive research on this issue has uncovered some important results and a relatively wide consensus about some aspects of this relationship has been reached. In particular, it is generally accepted now that inflation has a negative effect on medium and long-term growth.¹ Inflation impedes efficient resource allocation by obscuring the signaling

¹The authors are particularly grateful to Bruce Hansen for very helpful discussions and advice on the econometric issues. They also thank Paul Cashin, William Easterly, Stanley Fischer, Robert Flood, John McDermott, Peter Montiel, Ratna Sahay, Xavier Sala-i-Martin, two anonymous referees, and a number of colleagues in the IMF Institute for extremely useful comments.

¹See Barro (1991), Fischer (1983, 1993), Bruno and Easterly (1998), and Sbordone and Kuttner (1994). This link between low inflation and high growth has also been found by various regional studies, for example, by De Gregorio (1992) for Latin America, Hadjimichael, Ghura, and others (1995) for sub-Saharan Africa, and Fischer, Sahay, and Végh (1996) for transition economies.
role of relative price changes, the most important guide to efficient economic
decisionmaking (Fischer, 1993). If inflation is inimical to growth, it readily follows
that policymakers should aim at a low rate of inflation. But how low should
inflation be? Should the target inflation be 10 percent, 5 percent, or for that
matter, zero percent? More generally, at what level of inflation does the
relationship between inflation and growth become negative?

These are the questions that several recent empirical studies have examined,
focusing specifically on whether the relationship between inflation and long-run
growth is a nonlinear one. In other words, at some (low) rate of inflation, the
relationship is positive or nonexistent, but at higher rates it becomes negative. If such
a nonlinear relationship exists then it should be possible, in principle, to estimate
the inflexion point, or threshold, at which the sign of the relationship between the
two variables would switch. The possibility of such a nonlinear relationship was
first identified by Fischer (1993), who noted the existence of a positive relation-
ship at low rates of inflation and a negative one as inflation rose (which weakened
as inflation increased). Sarel (1996) specifically tested for the existence of a struc-
tural break in the relationship between inflation and growth and found evidence
of a significant structural break at an annual inflation rate of 8 percent. Below that
rate, inflation does not have a significant effect on growth, or it may even show a
slightly positive effect. For inflation rates greater than 8 percent, the effect is
negative, statistically significant, and strong. Ignoring the existence of this
threshold substantially biases the effect of inflation on growth. Ghosh and Phillips
(1998), using a larger sample than Sarel’s, find a substantially lower threshold
effect at 2.5 percent annual inflation rate. They also find that inflation is one of
the most important statistical determinants of growth. Christoffersen and Doyle
(1998) estimate the threshold level at 13 percent for transition economies. Bruno
and Easterly (1998) argue that the negative relationship between inflation and
growth, typically found in cross-country regressions, exists only in high-
frequency data and with extreme inflation observations. They find no cross-
sectional correlation between long-run averages of growth and inflation in the full
sample, but detect a negative effect of inflation and growth for inflation rates
higher than 40 percent. A useful discussion of previous work on this issue is
given in Ghosh (2000).

This paper re-examines the nature of the relationship between inflation and
growth, focusing specifically on the following questions:

- Is there a statistically significant threshold level of inflation above which
  inflation affects growth differently than at lower inflation rates?

2It has been argued that what matters for efficient resource allocation is not so much the level of infla-
tion but its variance. However, to the extent that the variance of inflation is positively related to its level—
see Bulkley (1984), Ball (1992), Grier and Perry (1996), and Ma (1998)—the latter does affect resource
allocation. While theory seems to suggest that the variability of inflation should affect growth more than
its level, empirical studies show the opposite result (see Fischer 1993).

3See, for example, Fischer (1993), Sarel (1996), Ghosh and Phillips (1998), Christoffersen and Doyle
(1998), and Bruno and Easterly (1998).

4This finding has been confirmed in a separate study by Easterly (1996).
• Is the threshold effect similar across developing and industrial countries?
• Considering that the studies discussed above arrive at different threshold estimates, are these threshold values statistically different?
• How robust is the Bruno-Easterly finding that the negative relationship between inflation and growth exists only for high-inflation observations and for high-frequency data?

These questions are examined using new econometric methods for threshold estimation and inference. There are two particular econometric issues related to the estimation and inference in models with threshold effects. First, the asymptotic distribution of the $t$-statistic on the threshold variable is nonstandard and requires bootstrap methods to compute its significance level. Second, methods need to be developed to conduct inference in the context of panel models with threshold effects.

I. Data Issues

The dataset includes 140 countries (comprising both industrial and developing countries) and generally covers the period 1960–98. Data for a number of developing countries, however, have a shorter span. Because of the uneven coverage, the analysis is conducted using unbalanced panels. The data come primarily from the World Economic Outlook (WEO) database for the following variables: the growth rate of GDP in local currency in constant 1987 prices, inflation computed as the growth rate of the CPI index, the initial income level measured as the five-year average of GDP per capita in 1987 PPP prices, gross domestic investment as a share of GDP, population growth, the growth rate of terms of trade, and the five-year standard deviation of terms of trade.

Figure 1 shows the relationship between real GDP growth and the logarithm of inflation ($\pi$). The data have been smoothed out by reducing the full sample to five observations. The latter are the arithmetic means of five equal subsamples corresponding to increasing levels of inflation.

We can see from Figure 1 that the relationship between real GDP growth and the log of inflation is slightly positive for low levels of inflation and becomes negative for higher inflation levels, corroborating the findings of Ghosh and Phillips (1998). Note also that the negative effect of inflation on growth weakens somewhat at higher inflation rates, supporting Fischer’s (1993) findings.

Should growth be related to the level or the log of inflation? The first panel in Figure 2 shows the distribution of inflation across the full sample of countries and time periods. It is clear that the distribution is highly skewed. A regression of real GDP growth on the level of inflation would give much weight to the extreme inflation observations, even though the bulk of the observations correspond to low and medium inflation rates. As suggested by Sarel (1996), the log transformation elim-
Mohsin S. Khan and Abdelhak S. Senhadji

Figure 1. Relationship Between Real GDP Growth and Inflation

![Graph showing the relationship between real GDP growth and inflation.]

...inates, at least partially, the strong asymmetry in the inflation distribution (see second panel in Figure 2). In the class of nonlinear models, Ghosh and Phillips (1998) show that the log transformation provides the best fit. Finally, the log transformation can be justified by the fact that its implications are more plausible than those of a linear model. In particular, the linear model implies that additive inflation shocks will have identical effects on growth in low- and high-inflation economies, while the log model implies that multiplicative inflation shocks will have identical effects on low- and high-inflation economies. For example, in the linear model, an increase in inflation by 10 percentage points will have the same effect on growth in an economy with an initial inflation rate of 10 percent as in an economy with an initial inflation rate of 100 percent. In the log model, a doubling of the inflation rate in those two economies will have the same effect on growth.

II. Model Specification and Estimation

To test for the existence of a threshold effect, the following model was estimated:

\[ d \log(y_t) = \mu_1 + \mu_2 + \gamma_1 (1 - d_{it}^{\pi_*}) \left( (\pi_{it} - 1) I(\pi_{it} \leq 1) + \frac{\log(\pi_{it}) - \log(\pi^*)}{\pi_{it} > 1} \right) + \gamma_2 d_{it}^{\pi_*} \left( (\pi_{it} - 1) I(\pi_{it} \leq 1) + \frac{\log(\pi_{it}) - \log(\pi^*)}{\pi_{it} > 1} \right) + \Theta X_{it} + \varepsilon_{it} \]

where

\[ d_{it}^{\pi_*} = \begin{cases} 1 & \text{if } \pi_{it} > \pi^* \\ 0 & \text{if } \pi_{it} \leq \pi^* \end{cases} \quad i = 1, ..., N; \quad t = 1, ..., T \]
Figure 2. Distribution of Inflation

Inflation in Levels

Logarithm of Inflation

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where \( d\log(y_t) \) is the growth rate of real GDP, \( \mu_i \) is a fixed effect, \( \mu_t \) is a time effect, \( \pi_t \) is inflation based on the CPI index, \( \pi^* \) is the threshold level of inflation, \( d_i \) is a dummy variable that takes a value of one for inflation levels greater than \( \pi^* \) percent and zero otherwise, \( I(\pi_t \leq 1) \) and \( I(\pi_t > 1) \) are indicator functions—that is, functions that take the value of one if the term between parentheses is true, and zero otherwise—\( X_{it} \) is a vector of control variables which includes investment as a share of GDP (igdp), population growth (dlog(pop)), the log of initial income per capita (log(yi0)), the growth rate of terms of trade (dlog(tot)), and the five-year standard deviation of terms of trade (\( \sigma_{tot} \)). The index “i” is the cross-sectional index, while “t” is the time-series index.

For reasons discussed above, the log of inflation is preferable to the level of inflation as explanatory variable in equation (1). However, the log function does not exist for negative inflation rates. Furthermore, the log function approaches minus infinity for inflation rates close to zero. Thus, the strategy adopted here is to specify a hybrid function of inflation which is linear for values of inflation rates below or equal to one and logarithmic for inflation rates greater than one. That function is:

\[
f(\pi_{it}) = (\pi_{it} - 1)I(\pi_{it} \leq 1) + \log(\pi_{it})I(\pi_{it} > 1)
\]

The first term is simply the level of inflation, \( \pi_{it} \), multiplied by an indicator function which disregards all observations with inflation rates above one, and thus \( f(\pi_{it}) \) is equal to \( (\pi_{it} - 1) \) for \( \pi_{it} \leq 1 \). Similarly, the second term is the log of inflation, \( \log(\pi_{it}) \), multiplied by an indicator function which disregards all observations with inflation rates below or equal to one, and thus \( f(\pi_{it}) \) is equal to \( \log(\pi_{it}) \) for \( \pi_{it} > 1 \). We subtract one from the first term to allow \( f(\pi_{it}) \) to be continuous at unity, where the function changes from being linear in \( \pi_{it} \) to being logarithmic in \( \pi_{it} \). The function \( f(\pi_{it}) \) is also continuously differentiable. Consequently, \( f(\pi_{it}) \) allows us to take into account all observations, including observations with negative inflation rates. Finally, the subtraction of \( \log(\pi^*) \) from \( \log(\pi_{it}) \) makes the relationship between growth and inflation, described by equation (1), continuous at the threshold level \( \pi^* \).

Note that \( X_{it} \) contains only the most important variables among the large set found in the empirical growth literature because very few of these variables pass the robustness tests in Levine and Renelt (1992) and Sala-i-Martin (1997). Furthermore, the model explicitly takes into account the individual country effects through \( \mu_i \) and the time effect through \( \mu_t \). The effect of inflation on GDP growth is given by \( \gamma_1 \) for countries in which inflation is less than or equal to \( \pi^* \) percent, and \( \gamma_2 \) for countries with inflation rates higher than \( \pi^* \) percent.

---

7The growth rate of a variable \( x \) is computed as the first difference of \( \log(x) \).
8We are grateful to the referee for suggesting this particular approach.
9Continuity of the relationship given by equation (1) is desirable, otherwise small changes in the inflation rate around the threshold level will yield different impacts on growth depending on whether inflation is increasing or decreasing.
THRESHOLD EFFECTS IN THE RELATIONSHIP BETWEEN INFLATION AND GROWTH

In order to smooth out business cycle fluctuations and focus on the medium- and long-term relationship between inflation and growth, equation (1) has been estimated using five-year averages of the data in the panel of 140 countries and 39 annual observations each. Therefore, the time dimension reduces to eight observations: 1960–64, 1965–69, 1970–74, 1975–79, 1980–84, 1985–89, 1990–94, and 1995–98 (the last observation is an average over four observations only).\(^{10}\) Potentially the dimension of the panel would be 140 x 8 = 1,120 observations. However, because of missing observations, the dimension of the unbalanced panel is smaller.

Estimation Method

If the threshold were known, the model could be estimated by ordinary least squares (OLS). Since \(\pi^*\) is unknown, it has to be estimated along with the other regression parameters. The appropriate estimation method in this case is non-linear least squares (NLLS). Furthermore, since \(\pi^*\) enters the regression in a non-linear and non-differentiable manner, conventional gradient search techniques to implement NLLS are inappropriate. Instead, estimation has been carried out with a method called conditional least squares, which can be described as follows. For any \(\pi^*\), the model is estimated by OLS, yielding the sum of squared residuals as a function of \(\pi^*\). The least squares estimate of \(\pi^*\) is found by selecting the value of \(\pi^*\) which minimizes the sum of squared residuals. Stacking the observation in vectors yields the following compact notation for equation (1):

\[
dlog(Y) = X\beta_{\pi} + e, \quad \pi = \pi_1, ..., \pi_T
\]

where \(\beta_{\pi} = (\mu, \mu, \gamma_1, \gamma_2, \theta)^T\) is the vector of parameters and \(X\) is the corresponding matrix of observations on the explanatory variables. Note that the coefficient vector \(\beta\) is indexed by \(\pi\) to show its dependence on the threshold level of inflation, the range of which is given by \(\pi\) and \(\bar{\pi}\). Define \(S_1(\pi)\) as the residual sum of squares with the threshold level of inflation fixed at \(\pi\). The threshold estimate level \(\pi^*\) is chosen so as to minimize \(S_1(\pi)\), that is:

\[
\pi^* = \arg\min_{\pi} \{S_1(\pi), \pi = \pi_1, ..., \pi_T\}
\]

Inference

It is important to determine whether the threshold effect is statistically significant. In equation (1), to test for no threshold effects amounts simply to testing the null hypothesis \(H_0: \gamma_1 = \gamma_2\). Under the null hypothesis, the threshold \(\pi^*\) is not identified, so classical tests, such as the \(t\)-test, have nonstandard distributions. Hansen

\(^{10}\)The initial income variable \(l_{y_{0}}\) is computed as the five-year average of real income per capita in PPP terms for the previous five-year period, allowing the identification of \(l_{y_{0}}\) under fixed effects.
Mohsin S. Khan and Abdelhak S. Senhadji

(1996, 1999) suggests a bootstrap method to simulate the asymptotic distribution of the following likelihood ratio test of \( H_0 \):

\[
LR_0 = \frac{(S_0 - S_1)}{\hat{\sigma}^2}
\]

where \( S_0 \) and \( S_1 \) are the residual sum of squares under \( H_0 \): \( \gamma_1 = \gamma_2 \), and \( H_1 \): \( \gamma_1 \neq \gamma_2 \), respectively; and \( \hat{\sigma}^2 \) the residual variance under \( H_1 \). In other words, \( S_0 \) and \( S_1 \) are the residual sum of squares for equation (1) without and with threshold effects, respectively. The asymptotic distribution of \( LR_0 \) is nonstandard and strictly dominates the \( \chi^2 \) distribution. The distribution of \( LR_0 \) depends in general on the moments of the sample; thus critical values cannot be tabulated. Hansen (1999) shows how to bootstrap the distribution of \( LR_0 \).

An interesting question is whether an inflation threshold, for example, of 10 percent is significantly different from a threshold of 8 percent or 15 percent. In other words, can the concept of confidence intervals be generalized to threshold estimates? Chan and Tsay (1998) show that in the case of a continuous threshold model studied here, the asymptotic distribution of all parameters, including the threshold level, have a normal distribution.\(^{11}\) More precisely, define \( \Phi = (\mu, \mu, \gamma_1, \gamma_2, \theta', \pi^*) \) as the set of all parameters, including the threshold level. Chan and Tsay (1998) show that the NLLS estimate \( \hat{\Phi} \) of \( \Phi \) (described above) is asymptotically normally distributed:\(^{12}\)

\[
\hat{\Phi} \sim N(\Phi, U^{-1}VU^{-1})
\]

where \( U = E(H_{it}H_{it}'), V = E(e_{it}H_{it}H_{it}') \), \( H_{it} = (\tilde{X}_{it}, \gamma_1(1 - d_{it}x) + \gamma_2d_{it}x, \gamma_2d_{it}x) \), \( \tilde{X}_{it} \) is the vector of all right-hand-side variables in equation (1), and \( NT \) is the total number of observations. An estimate of \( U \) and \( V \) are given by

\[
\hat{U} = \sum_{m=1}^{N} \sum_{t=1}^{T} \hat{H}_{it}H_{it}/(NT) \quad \text{and} \quad \hat{V} = \sum_{m=1}^{N} \sum_{t=1}^{T} \hat{e}_{it}H_{it}H_{it}'/(NT) \quad \text{with} \quad \hat{H}_{it} = (\tilde{X}_{it}, \gamma_1(1 - d_{it}x) + \gamma_2d_{it}x, \gamma_2d_{it}x).
\]

III. Estimation and Inference Results

Test for Existence of Threshold Effects

The first step is to test for the existence of a threshold effect in the relationship between real GDP growth and inflation using the likelihood ratio, \( LR_0 \), discussed above. This involves estimating equation (1) and computing the residual sum of squares (RSS) for threshold levels of inflation ranging from \( \pi \) to \( \pi \). The threshold estimate is the one that minimizes the sequence of RSSs. The test for the existence of threshold effects has been conducted using the full sample and two subsamples (industrial and developing countries). The results are summarized in Table 1.

---

\(^{11}\)Hansen (2000) derives the asymptotic distribution for the discontinuous threshold model.

\(^{12}\)For an application of this method, see Cox, Hansen, and Jimenez (1999).
Table 1. Test Results of Threshold Effects

<table>
<thead>
<tr>
<th>Sample</th>
<th>Search Range for Thresholds</th>
<th>Threshold Estimate (%)</th>
<th>LR0</th>
<th>Critical Values</th>
<th>Significance Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Countries</td>
<td>{1, 2, 3,..., 100}</td>
<td>11</td>
<td>10.59</td>
<td>7.47</td>
<td>0.001</td>
</tr>
<tr>
<td>Industrial Countries</td>
<td>{1, 2, 3,..., 30}</td>
<td>1</td>
<td>8.80</td>
<td>6.63</td>
<td>0.005</td>
</tr>
<tr>
<td>Developing Countries</td>
<td>{1, 2, 3,..., 100}</td>
<td>11</td>
<td>10.89</td>
<td>6.21</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Note: The second column gives the range over which the search for the threshold effect is conducted, the third column gives the threshold estimate in percent, the column LR0 gives the observed value of the likelihood ratio, the fifth column gives the critical values, and the last column gives the corresponding significance level, both computed using the bootstrap distributions (corresponding to the three samples) of LR0. For a more detailed discussion on the computation of the bootstrap distribution of LR0, see Hansen (1999).

The second column gives the range over which the search for the threshold effect is conducted. For the full sample, π = 1 percent, π = 100 percent, and the increment is 1 percent, which yields 100 panel regressions of equation (1).13 The minimization of the vector of 100 RSSs occurs at the inflation level of 11 percent (see Figure 3). Repeating the same procedure for the subsamples yields a threshold estimate of 11 percent for developing countries and 1 percent for industrial countries. Note that the threshold level for industrial countries is much lower than that for developing countries.14 The column LR0 in Table 1 gives the observed value of the likelihood ratio. The significance levels have been computed using the bootstrap distributions (corresponding to the three samples) of LR0.15 The null hypothesis of no threshold effects can be rejected at least at the 1 percent significance level for all three samples. Thus the data strongly support the existence of threshold effects.

Estimation Results

Table 2 provides the estimation results of equation (1) for the three samples. Fixed effects and time dummies have been included (but not reported) to control for cross-country heterogeneity and time effects. For the full sample, for which the threshold estimate is 11 percent, all coefficients have the right sign and are statistically significant at the 1 percent level. Recall that the existence of a threshold effect cannot be inferred simply from a classical test of equality between γ1 and γ2 as the distribution of the t-statistic for this variable is highly nonstandard under the null hypothesis of no threshold effect. This is why the null hypothesis has been tested using the boot-

13For industrial countries the upper bound has been set to 30 percent.
14Since the threshold estimate occurs at the lower bound of the search range for developed countries (corner solution), the question is whether the minimum is at 1 percent or less than 1 percent. This question cannot be answered with five-year-averaged observations as there are only 12 observations with an inflation rate below 1 percent for industrial countries. However, this question will be re-examined in the next section with yearly data which provide more observations with low inflation.
15For a more detailed discussion on the computation of the bootstrap distribution of LR0, see Hansen (1999).
Figure 3. Residual Sum of Squares as a Function of the Threshold Level (Five-Year Average)

Industrial Countries

Developing Countries

Full Sample

Note: Figure 3 shows the residual sum of squares (RSS) from equation (1) as a function of the threshold level of inflation for the three samples. The minimum of the RSS sequence determines the threshold estimate, which occurs at 1 percent for industrial countries, and 11 percent for developing countries and the full sample.
Table 2. NLLS With Fixed Effects (Five-Year Average)

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>All</th>
<th>Industrial</th>
<th>Developing</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1–dx*)[log(π)–log(π*)]</td>
<td>0.00049</td>
<td>0.05991</td>
<td>0.00109</td>
</tr>
<tr>
<td></td>
<td>(-0.66)</td>
<td>(2.53)a</td>
<td>(1.33)</td>
</tr>
<tr>
<td>dx*[log(π)–log(π*)]</td>
<td>-0.00895</td>
<td>-0.00643</td>
<td>-0.00895</td>
</tr>
<tr>
<td></td>
<td>(-4.70)a</td>
<td>(-4.23)a</td>
<td>(-4.42)a</td>
</tr>
<tr>
<td>ly0</td>
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<td>-0.03634</td>
<td>-0.02551</td>
</tr>
<tr>
<td></td>
<td>(-13.20)a</td>
<td>(-15.58)a</td>
<td>(-11.08)a</td>
</tr>
<tr>
<td>igdp</td>
<td>0.15090</td>
<td>0.10640</td>
<td>0.15910</td>
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<tr>
<td></td>
<td>(5.01)a</td>
<td>(3.47)a</td>
<td>(4.96)a</td>
</tr>
<tr>
<td>dlog(pop)</td>
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<td>-0.01557</td>
<td>0.05095</td>
</tr>
<tr>
<td></td>
<td>(2.33)a</td>
<td>(-0.23)</td>
<td>(2.33)a</td>
</tr>
<tr>
<td>rtot</td>
<td>-0.00020</td>
<td>-0.00031</td>
<td>-0.00019</td>
</tr>
<tr>
<td></td>
<td>(-2.56)a</td>
<td>(-1.17)</td>
<td>(-2.33)a</td>
</tr>
<tr>
<td>Threshold (%)</td>
<td>11</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>(64.42)a</td>
<td>(9.10)a</td>
<td>(58.59)a</td>
</tr>
<tr>
<td>NxT</td>
<td>905</td>
<td>165</td>
<td>740</td>
</tr>
<tr>
<td>R²</td>
<td>0.43</td>
<td>0.80</td>
<td>0.39</td>
</tr>
</tbody>
</table>

Note: The panel has 8 observations (T), that is five-year averages over 1960–98, for 140 countries (N). The variables are inflation, π; the log of initial income, log; gross domestic investment over GDP, igdp; the growth rate of population, dlog(pop); and the standard deviation of terms of trade, σ(tot). The dummy variable dx takes one for inflation rates greater than the threshold estimate (π*) and zero otherwise. The t-statistics, given in parentheses, are computed from White heteroskedasticity-consistent standard errors. The letters “a”, “b”, “c”, indicate statistical significance at 1, 5, and 10 percent, respectively. The growth rate of a variable x is approximated by the first difference of the log of x, dlog(x).

The estimated time dummies and country-specific effects are not reported.

strap distribution of the likelihood ratio LR0(π). However, the distribution of the t-values of all explanatory variables retain their usual distribution under the alternative hypothesis of a threshold effect. Furthermore, Chan and Tsay (1998) show that the asymptotic distribution of all coefficients, including the threshold, is multivariate normal with a variance-covariance matrix given by equation (6).

In the previous sub-section, we established the existence of a threshold for all three samples; the next important question is how precise are these estimates? This requires the computation of the confidence region around the threshold estimate. While the existence of threshold effects in the relationship between inflation and growth is well accepted, the precise level of the inflation threshold is still subject to debate. Indeed, as discussed earlier, based on existing studies, the range could be between 2.5 percent and 40 percent. If the confidence region shows that the threshold estimate is not significantly different from a large number of other potential threshold levels, that would imply that there is substantial uncertainty about the threshold level. Interestingly, the confidence intervals here are very tight, which implies that the thresholds are precisely estimated. Indeed, the 95 percent confidence intervals for the whole sample, industrial countries, and developing countries, are [10.66, 11.34], [0.89, 1.11], and [10.62, 11.38], respectively.
Two basic conclusions can be drawn from this set of statistical tests. First, the threshold is around an inflation rate of 1 percent for industrial economies and 11 percent for developing countries. Second, these threshold estimates are very precise. One needs to ask why the threshold level for developing countries is higher than the threshold level for industrial countries. There are at least two possible conjectures that we can make. First, the long history of inflation in many developing countries led them to adopt widespread indexation systems to negate, at least partially, the adverse effects of inflation. Once in place, these indexation mechanisms make it possible for governments in these countries to run higher rates of inflation without experiencing adverse growth effects (because relative prices do not change that much). Second, to the extent that inflation is viewed as a tax on financial intermediation, governments, faced with a target level of expenditure will, in the absence of conventional taxes, levy the inflation tax. Accordingly, the differential threshold levels for the effects of inflation on growth for industrial and developing countries could reflect the higher level of conventional taxation in the former than in the latter. Thus, while relatively small increases in inflation in industrial countries adversely affect investment (by raising the effective cost of capital goods), productivity, and growth, in developing countries, with relatively low levels of conventional taxes, a larger inflation tax is required to have the same growth-inhibiting effects.16

While inflation below its threshold level has no significant effect on growth, inflation rates above the threshold level have a significant negative effect on growth for the whole sample. Dividing the sample into industrial and developing countries yields some interesting insights. First, both groups show a positive relationship between growth and inflation below their respective threshold levels (although it is statistically significant only for industrial countries for which the threshold level is at 1 percent), and a significant and a more powerful negative relationship for inflation rates above the threshold. As expected, investment as a share of GDP and population growth have a positive and significant effect on growth (except for industrial countries for which population growth is statistically insignificant). On average, an increase in the investment–GDP ratio of 5 percentage points will boost real GDP growth by 0.80 percentage points for developing countries and by 0.53 percentage points for industrial countries.

In the empirical growth literature, the log of the initial GDP per capita \( \ln(y_0) \) has been generally included in growth regressions to test conditional convergence. Conditional convergence holds if the coefficient on \( \ln(y_0) \) is negative.17 Thus, convergence occurs for all samples. The rate of convergence among industrial countries is faster than for developing countries, corroborating the results of previous studies, which find that conditional convergence is stronger among industrial countries.18

The first three panels of Table 3 illustrate the regression results reported in Table 2 for the full sample, for industrial countries, and for developing countries.

---
16Roubini and Sala-i-Martin (1995) and Cukierman, Edwards, and Tabellini (1992) have developed models that yield results along these lines. We are grateful to Paul Cashin and John McDermott for bringing this possible explanation to our attention.

17A negative coefficient on \( \ln(y_0) \) implies that countries with initially low income per capita tend to grow faster than countries with higher income per capita.

18See, for example, Mankiw, Romer, and Weil (1992).
Table 3. Numerical Illustration of the Effects of Inflation on Growth

<table>
<thead>
<tr>
<th>Threshold π</th>
<th>Five-Year-Average</th>
<th>Yearly Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>Industrial</td>
</tr>
<tr>
<td>4</td>
<td>0.01</td>
<td>-0.18</td>
</tr>
<tr>
<td>5</td>
<td>0.02</td>
<td>-0.33</td>
</tr>
<tr>
<td>6</td>
<td>0.03</td>
<td>-0.45</td>
</tr>
<tr>
<td>9</td>
<td>0.05</td>
<td>-0.71</td>
</tr>
<tr>
<td>11</td>
<td>0.06</td>
<td>-0.84</td>
</tr>
<tr>
<td>15</td>
<td>-0.21</td>
<td>-1.03</td>
</tr>
<tr>
<td>20</td>
<td>-0.47</td>
<td>-1.22</td>
</tr>
<tr>
<td>25</td>
<td>-0.67</td>
<td>-1.36</td>
</tr>
<tr>
<td>30</td>
<td>-0.83</td>
<td>-1.48</td>
</tr>
<tr>
<td>40</td>
<td>-1.09</td>
<td>-1.66</td>
</tr>
<tr>
<td>60</td>
<td>-1.45</td>
<td>-1.93</td>
</tr>
</tbody>
</table>

Note: This table shows the effect on growth of gradually increasing inflation from an initial inflation rate (π₀) of 3 percent to 60 percent, using estimates of the fixed-effects model with yearly and five-year-average data. For example, increasing inflation from 3 percent to 25 percent entails a loss in growth of 1.17 percent using the full sample estimates with yearly data. Shaded areas indicate a crossing of a threshold.

respectively. The three panels show the effect on growth of gradually increasing inflation for a hypothetical economy with an initial inflation rate of 3 percent. The maximum growth that a developing country, with an initial inflation rate of 3 percent, can gain through further inflation is 0.14 percentage points (by moving from an annual inflation rate of 3 percent to 11 percent). This magnitude very likely overestimates the positive effect of inflation as investment over GDP (igdp) was held constant while moving inflation from 3 to 11 percent. However, Fischer (1993) has shown that inflation also has a negative and significant indirect effect on growth through its effect on investment. This indirect effect is not taken into account here. From our results, the positive effect rapidly changes into a negative one as inflation increases above the threshold. For example, an increase in inflation from 3 to 40 percent will reduce growth by 1.01 percentage points in developing countries and by 1.66 percentage points in industrial countries. The effect of inflation on growth for any pair of inflation rates in the first column is simply equal to the difference between their growth effects. For example, reducing a developing country’s annual inflation rate from 60 percent to 15 percent will increase its GDP growth by 1.24 percentage points. The log transformation implies that the effect on growth will be identical for an economy that moves from a 3 percent inflation rate to 6 percent and an economy that increases its inflation rate from 4 percent to 8 percent. This is because, in both cases, the inflation rate is doubled. Of course, this property holds only for inflation changes that do not induce a crossing of the threshold.

19The shaded areas in Table 3 indicate inflation rates that are above the threshold level of inflation.
IV. Robustness

Sensitivity to Fixed Effects

Since panel estimation can be quite sensitive to the use of fixed effects, equation (1) has also been estimated without fixed effects. Tables 2 and 4 show similar results. In particular, the estimates of threshold levels are identical. However, omitting fixed effects weakens the negative effect of inflation on growth for developing countries above the threshold level of inflation, and lowers the rate of convergence among countries.

Sensitivity to High-Inflation Observations

Bruno and Easterly (1998) and Easterly (1996) have argued that the negative relationship between inflation and growth holds only for high-inflationary economies. They show that excluding observations with annual inflation rates of 40 percent or more weakens the negative relationship between inflation and

<table>
<thead>
<tr>
<th>Table 4. NLLS Without Fixed Effects (Five-Year Average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable: $d \log(gdp)$</td>
</tr>
<tr>
<td>Independent Variables</td>
</tr>
<tr>
<td>$(1-d^<em>)[\log(\pi)-\log(\pi^</em>)]$</td>
</tr>
<tr>
<td>($0.98$)</td>
</tr>
<tr>
<td>$d^<em>[\log(\pi)-\log(\pi^</em>)]$</td>
</tr>
<tr>
<td>($-2.71)a</td>
</tr>
<tr>
<td>$ly_0$</td>
</tr>
<tr>
<td>($-7.52)a</td>
</tr>
<tr>
<td>$igdp$</td>
</tr>
<tr>
<td>($7.78)a</td>
</tr>
<tr>
<td>$d \log(pop)$</td>
</tr>
<tr>
<td>($3.06)a</td>
</tr>
<tr>
<td>$\sigma_{tot}$</td>
</tr>
<tr>
<td>($-2.61)a</td>
</tr>
<tr>
<td>Threshold estimate (%)</td>
</tr>
<tr>
<td>($25.42)a</td>
</tr>
<tr>
<td>NxT</td>
</tr>
<tr>
<td>$R^2$</td>
</tr>
</tbody>
</table>

Note: The panel has 8 observations (T), that is five-year averages over 1960–98, for 140 countries (N). The variables are inflation, $\pi$; the log of initial income, $ly_0$; gross domestic investment over GDP, $igdp$; the growth rate of population, $d \log(pop)$; and the standard deviation of terms of trade, $\sigma_{tot}$. The dummy variable $d^*$ takes one for inflation rates greater than the threshold estimate ($\pi^*$) and zero otherwise. The $t$-statistics, given in parentheses, are computed from White heteroskedasticity-consistent standard errors. The letters "a", "b", "c", indicate statistical significance at 1, 5, and 10 percent, respectively. The growth rate of a variable $x$ is approximated by the first difference of the log of $x$, $d \log(x)$. The estimated time dummies and country-specific effects are not reported.
Table 5. NLLS With Fixed Effects (Five-Year Average)

Excluding Observations With Inflation Greater Than 40 Percent Dependent Variable: $d\log(gdp)$

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>All</th>
<th>Industrial</th>
<th>Developing</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(1-d^<em>) [\log(\pi)-\log(\pi^</em>)]$</td>
<td>0.00101</td>
<td>0.06227</td>
<td>0.00166</td>
</tr>
<tr>
<td></td>
<td>(13.4)</td>
<td>(2.77)a</td>
<td>(1.85)c</td>
</tr>
<tr>
<td>$d^* [\log(\pi)-\log(\pi^*)]$</td>
<td>-0.01983</td>
<td>-0.00709</td>
<td>-0.02067</td>
</tr>
<tr>
<td></td>
<td>(-9.04)a</td>
<td>(-4.10)a</td>
<td>(-9.02)a</td>
</tr>
<tr>
<td>$l_{90}$</td>
<td>-0.02286</td>
<td>-0.03461</td>
<td>-0.02299</td>
</tr>
<tr>
<td></td>
<td>(-9.00)a</td>
<td>(-13.91)a</td>
<td>(-6.89)a</td>
</tr>
<tr>
<td>$igdp$</td>
<td>0.15100</td>
<td>0.09860</td>
<td>0.16100</td>
</tr>
<tr>
<td></td>
<td>(4.71)a</td>
<td>(2.83)a</td>
<td>(4.77)a</td>
</tr>
<tr>
<td>$d\log(pop)$</td>
<td>0.06509</td>
<td>-0.00132</td>
<td>0.06595</td>
</tr>
<tr>
<td></td>
<td>(3.06)a</td>
<td>(-0.02)</td>
<td>(3.01)a</td>
</tr>
<tr>
<td>$\sigma_{tot}$</td>
<td>-0.00027</td>
<td>-0.00040</td>
<td>-0.00026</td>
</tr>
<tr>
<td></td>
<td>(-2.43)a</td>
<td>(-0.98)</td>
<td>(-2.25)b</td>
</tr>
<tr>
<td>Threshold estimate (%)</td>
<td>12</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>(130.21)a</td>
<td>(9.94)a</td>
<td>(123.11)a</td>
</tr>
<tr>
<td>NxT</td>
<td>838</td>
<td>160</td>
<td>678</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.43</td>
<td>0.80</td>
<td>0.39</td>
</tr>
</tbody>
</table>

Note: The panel has 8 observations (T), that is five-year averages over 1960-98, for 140 countries (N). The variables are inflation, $\pi$; the log of initial income, $l_{90}$; gross domestic investment over GDP, $igdp$; the growth rate of population, $d\log(pop)$; and the standard deviation of terms of trade, $\sigma_{tot}$. The dummy variable $d^*$ takes one for inflation rates greater than the threshold estimate ($\pi^*$) and zero otherwise. The $t$-statistics, given in parentheses, are computed from White heteroskedasticity-consistent standard errors. The letters "a", "b", "c", indicate statistical significance at 1, 5, and 10 percent, respectively. The growth rate of a variable $x$ is approximated by the first difference of the log of $x$, $d\log(x)$. The estimated time dummies and country-specific effects are not reported.

growth. Their methodology differs from ours in that theirs is not based on regression analysis but on mean comparisons before, during, and after inflation crises (defined as inflation episodes above 40 percent). To test their hypothesis within our framework, equation (1) was re-estimated with five-year-averaged data excluding observations with inflation rates higher than 40 percent. The results are presented in Table 5.

The results turn out to be very close to the estimates with the full sample (given in Table 2). In fact, the threshold estimates without high inflation observations for developing countries are almost identical to the estimates obtained with all the data.\textsuperscript{20}

Sensitivity to the Location of the Threshold

Figure 4 shows the sensitivity of the effect of inflation on growth when the threshold level varies from 1 percent to 50 percent. The three panels (corresponding to the three samples) depict the effect of inflation on growth for

\textsuperscript{20}In Table 5, the elimination of observations with inflation rates above 40 percent restricts the grid over which the search for threshold effects can be conducted.
economies with an inflation rate below the threshold level (solid line) and for economies with inflation rates above the threshold level (dotted line). These effects are given by the coefficients $y_1$ and $y_2$ in equation (1). The vertical line indicates the threshold estimate. The following points emerge from Figure 4:

(i) the high- and low-inflation effects are most sensitive to the location of the threshold over the 1 to 20 percent range;

(ii) the positive effect of inflation on growth is only present for inflation rates lower than 5 percent for industrial countries and 18 percent for developing countries;

(iii) for developing countries, the inflation effect on growth, which is negative over the whole range, strengthens as the threshold increases, which implies a worsening of the negative effect of inflation on growth as inflation increases; and

(iv) for industrial countries, the inflation effect, while remaining negative over the entire range, first weakens (in absolute value) as the inflation threshold increases, reaches a minimum around a threshold of 15 percent, and strengthens thereafter.

Sensitivity to Data Frequency

The estimation and inference in the previous section were based on five-year averages of the data. This procedure has become common practice in empirical growth literature and aims at filtering out business cycle fluctuations and allowing the focus to be on the medium- and long-term trends in the data. Estimation of equation (1) has also been carried out with annual data in order to examine two issues. First, it is interesting to analyze how data frequency changes the location and the magnitude of the threshold effect and the parameter estimates of equation (1). Second, while noisier, annual data provide more degrees of freedom, especially at the tails of the distribution for inflation. In particular, the inflation threshold for industrial countries was estimated at 1 percent, which was the lower bound of the grid search for threshold effects. The question raised earlier was whether the threshold was at 1 percent or at less than 1 percent. With the five-year averages, there were not enough observations with inflation below 1 percent, whereas annual data provide enough low-inflation observations to answer the question.

Table 6 gives the threshold estimate and parameter estimates of equation (1). A comparison of Tables 2 and 6 reveals some interesting points. First, the threshold estimates are somewhat different but very close. The threshold estimates with yearly data are slightly higher for both industrial and developing countries (3 percent versus 1 percent for industrial countries, and 12 percent versus 11 percent for developing countries). Second, the high-inflation effect (that is, $y_2$) is more powerful for yearly data. This is illustrated in the last three columns of Table 3. As expected, the fit is poorer with yearly data, but the threshold levels of inflation are precisely estimated.

21 There is a small difference in the specification of equation (1) reported in Tables 2 and 6. In Table 2, equation (1) has the five-year standard deviation of terms of trade as an explanatory variable, whereas in Table 6, it is replaced by the growth rate of terms of trade since the standard deviation cannot be computed for yearly data. If both variables are included in equation (1), when estimated with five-year-averaged data, both become insignificant.
THRESHOLD EFFECTS IN THE RELATIONSHIP BETWEEN INFLATION AND GROWTH

Figure 4. Sensitivity of the Effect of Inflation on Growth to the Threshold Level (Five-Year Average)

Industrial Countries

Developing Countries

Full Sample

Note: The low (solid line) and high (dotted line) effects are respectively given by the coefficients $\gamma_1$ and $\gamma_2$ in equation (1). The threshold varies from 1 to 50 percent, except for industrial countries where the range is from 1 to 30 percent. The vertical line indicates the estimate of the inflation threshold.

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Table 6. NLLS With Fixed Effects (Yearly Data)

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>All</th>
<th>Industrial</th>
<th>Developing</th>
</tr>
</thead>
<tbody>
<tr>
<td>((1-d_{\pi}^{<em>})[\log(\pi)-\log(\pi^{</em>})])</td>
<td>0.00054</td>
<td>0.00143</td>
<td>0.00043</td>
</tr>
<tr>
<td>(d_{\pi}^{<em>}[\log(\pi)-\log(\pi^{</em>})])</td>
<td>((-1.99)b)</td>
<td>((-0.00923))</td>
<td>((-0.01347))</td>
</tr>
<tr>
<td>(I_{gdp})</td>
<td>0.07820</td>
<td>0.02690</td>
<td>0.07860</td>
</tr>
<tr>
<td>(d_{\log(pop)})</td>
<td>((-0.1557))</td>
<td>((-0.02750))</td>
<td>(-0.01701)</td>
</tr>
<tr>
<td>(d_{\log(tot)})</td>
<td>((-4.72E-05))</td>
<td>((-0.01583))</td>
<td>(-1.77E-05))</td>
</tr>
<tr>
<td>Threshold estimate (%)</td>
<td>9</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>NxT</td>
<td>4264</td>
<td>950</td>
<td>3414</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.14</td>
<td>0.50</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Note: The panel has potentially 39 observations (T), covering 1960–98, for 140 countries (N). The variables are inflation, \(\pi\); gross domestic investment over GDP, \(I_{gdp}\); the growth rate of population, \(d_{\log(pop)}\); and the growth rate of terms of trade, \(d_{\log(tot)}\). The dummy variable \(d_{\pi}^{*}\) takes one for inflation rates greater than the threshold estimate (\(\pi^{*}\)) and zero otherwise. The \(t\)-statistics, given in parentheses, are computed from White heteroskedasticity-consistent standard errors. The letters "a", "b", "c", indicate statistical significance at 1, 5, and 10 percent, respectively. The growth rate of a variable \(x\) is approximated by the first difference of the log of \(x\), \(d_{\log(x)}\). The estimated country-specific effects are not reported.

The 95 percent confidence intervals for the whole sample, industrial countries, and developing countries, are [8.78, 9.22], [2.76, 3.24], and [11.80, 12.20], respectively. Considering the few number of observations with very low inflation rates for the five-year-averaged data, the 3 percent threshold estimate (versus 1 percent with smoothed data) for industrial countries may well be more reliable.

**Sensitivity to Additional Explanatory Variables**

As explained in Section I, only variables that were found to be robust in the empirical growth literature were included in the regression equation linking inflation to growth. The use of fixed effects also helps capture cross-country differences in GDP growth. Since endogenous growth theory has emphasized the role of human capital in the growth process of a country, equation (1) has been augmented by including a human capital variable. Following the empirical growth literature, human capital is proxied by enrollment rates in the primary, secondary, and tertiary schools.\(^{22}\) All three variables came out statistically insignificant. Furthermore, their inclusion does not significantly change the results. In fact, the

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\(^{22}\)The data on enrollment were taken from the World Bank’s Global Development Network Growth Database maintained by William Easterly and Hairong Yu.
threshold values remain the same. The reason may be that the three proxies (primary, secondary, and tertiary enrollment) are highly correlated with the initial income variable \( y_0 \). A regression of the former on the latter yields an \( R^2 \) of 0.98, 0.92, and 0.98, respectively. In other words, the initial income variable appears to be picking up most of the cross-country variation in school enrollment.

Financial development is another important variable that was emphasized by King and Levine (1993). Following this approach, we used three different proxies for financial depth. The first measures the size of the formal financial intermediary sector relative to economic activity (the ratio of liquid liabilities of the financial system, measured by M3 when it is available and M2 otherwise, to GDP); the second proxy measures the proportion of credit allocated to the private sector (the ratio of claims on the nonfinancial private sector to total domestic credit); and the third is simply the second normalized by GDP instead of total domestic credit. Adding these variables did not change the estimated threshold values at all.

V. Conclusions

This paper re-examines the issue of the existence of threshold effects in the relationship between inflation and growth using new econometric techniques that provide appropriate procedures for estimation and inference. The data cover 140 developing and industrialized countries for the period 1960–98. Estimates were obtained for panels with five-year averaged data as well as yearly data.

The empirical results strongly suggest the existence of a threshold beyond which inflation exerts a negative effect on growth. The threshold is lower for industrial than for developing countries (the estimates are 1–3 percent and 11–12 percent for industrial and developing countries, respectively, depending on the estimation method). The thresholds are statistically significant at 1 percent or less. The confidence intervals are very tight, which implies that the threshold estimates are very precise.

The negative and significant relationship between inflation and growth for inflation rates above the threshold level is robust with respect to the estimation method, perturbations in the location of the threshold level, the inclusion or exclusion of high-inflation observations, data frequency, and alternative specifications. Interestingly, using yearly data yields threshold levels that are close to the estimates from the five-year-averaged data (12 percent for developing countries and 3 percent for industrial countries) and a stronger negative relationship between inflation and growth. Thus, as in Bruno and Easterly (1998), the relationship between inflation and growth is stronger at high frequencies. At the same time, our results suggest a strong and negative effect of inflation on growth even when data have been averaged over five years.

While the results are informative, some caveats are important to bear in mind when interpreting these results. First, the estimated relationship between inflation

---

23Data for these variables were taken from the IMF’s International Financial Statistics (IFS). Claims on the nonfinancial private sector is IFS line 32d and domestic credit is IFS lines 32a to 32f excluding 32e.

24As mentioned earlier, the period is shorter for a large number of developing countries.

25The confidence regions for the threshold estimates with yearly data are wider, reflecting the noisier nature of yearly data versus the five-year-averaged data.
and growth does not provide the precise channels through which inflation affects growth—beyond the fact that, because investment and employment are controlled for, the effect is primarily through productivity. This also implies that the total negative effect of inflation may be understated. Second, inflation is not an exogenous variable in the growth-inflation regression, and the coefficient estimates may be biased. The seriousness of this problem will depend, to a large extent, on whether the causality runs mainly from inflation to growth, in which case the endogeneity problem may not be serious, or the other way around, in which case a bias may be present. As argued by Fischer (1993), the causality is more likely to run predominantly from inflation to growth, in which case the problem of simultaneity bias may not be very important. However, this assumption needs to be explicitly tested. Finally, inflation may have adverse effects on the economy beyond that on growth. These effects have not been considered here and warrant serious study.

In conclusion, policymakers around the world during the last decade or so have recognized that lowering inflation is conducive to improved growth performance. The goal has become one of bringing inflation down to single digits, or close to single digits, and keeping it there. The results in this paper provide strong empirical support for this view.

REFERENCES


26Fischer (1993) examines the effects of inflation on investment, employment, and total factor productivity.

27The estimation method used here has not been extended to standard econometric methods of handling simultaneity.
THRESHOLD EFFECTS IN THE RELATIONSHIP BETWEEN INFLATION AND GROWTH


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A Peek Inside the Black Box: The Monetary Transmission Mechanism in Japan

JAMES MORSINK and TAMIM BAYOUMI*

This paper uses vector autoregressions to examine the monetary transmission mechanism in Japan. The empirical results indicate that both monetary policy and banks' balance sheets are important sources of shocks, that banks play a crucial role in transmitting monetary shocks to economic activity, that corporations and households have not been able to substitute borrowing from other sources for a shortfall in bank borrowing, and that business investment is especially sensitive to monetary shocks. We conclude that policy measures to strengthen banks are probably a prerequisite to restoring the effectiveness of the monetary transmission mechanism. [JEL E50, E51]

The mechanism for the transmission of monetary policy changes to real activity—the famous "black box"—is always a subject of lively interest to economists. Many channels have been identified, including interest rates, the exchange rate, inflationary expectations (higher expected inflation lowers the real interest rate), bank lending, balance sheet effects, and wealth effects, but there is little agreement on either their precise workings or their relative importance (see Mishkin, 1995).

When an economy is in a recession, such as Japan is experiencing currently, monetary policy and the channels of monetary transmission receive particular scrutiny. In the case of Japan, two further factors make understanding the trans-

*The authors would like to thank an anonymous referee and their IMF colleagues for valuable comments, especially Timothy Callen, Charles Collyns, Patricia Reynolds, and participants in an IMF Asia and Pacific Department seminar, and Fritz Pierre-Louis for excellent research assistance.
mission mechanism especially important. First, the Bank of Japan (BOJ) has steadily lowered the overnight call rate—the operating target for monetary policy—to “as low as possible,” which turns out to be 0.03 percent given transactions costs. With monetary policy bumping up against the nominal floor on interest rates, and attention shifting to a possible role for quantitative easing, examining the monetary transmission mechanism may provide some insight into the effectiveness of policies in this unusual environment.

Second, the 1990s slump in activity has been accompanied by a banking crisis. A growing body of research focuses on the bank lending channel of the monetary transmission mechanism (see Bernanke and Gertler, 1995; and Kashyap and Stein, 1997). Banks are seen as playing an important independent role in overcoming information problems and other frictions in credit markets, so that some borrowers (small firms, for example) cannot readily find substitutes for bank financing. As a result, changes to banks’ ability to lend—either reflecting monetary policy developments or other changes to bank capital and funding—are transmitted to bank-dependent borrowers. As banks play a particularly important role in Japan’s financial intermediation, the banking channel may be of particular significance as a conduit for monetary policy and, given the problems being experienced by the banking sector, as an independent source of real disturbances.

This paper uses vector autoregressions (VARs) to examine the monetary transmission mechanism in Japan. This methodology allows us to place minimal restrictions on how monetary shocks affect the economy, which—given the lack of consensus about the workings of the monetary transmission mechanism—is a distinct advantage. In addition, this approach recognizes explicitly the simultaneity between monetary policy and macroeconomic developments, that is, the dependence of monetary policy on other economic variables (the policy reaction function), as well as the dependence of economic variables on monetary policy. The choice of a VAR approach is also inspired by the existence of a large empirical literature using VARs to examine the monetary transmission mechanism in the United States, which focuses primarily on reduced-form relationships between monetary policy and output using a small number of variables (for a survey, see Christiano, Eichenbaum, and Evans, 1999). Compared to that literature, we look in more detail at the mechanics of the monetary transmission mechanism. The closest antecedent to this paper in the U.S. literature is Leeper, Sims, and Zha (1996), which also explores the workings of the transmission mechanism.

1By contrast, the wealth channel may be relatively unimportant in Japan given the limited ownership of equities by individuals.

2Two different views of the banking crisis are contained in the literature. Krugman (1998) argues that bank weakness has had little impact on the effectiveness of monetary policy as impaired banks tend to lend too much, not too little. By contrast, Bayoumi (1999) finds that the negative shocks to bank lending, either autonomous or caused by falling asset prices, provided a major deflationary impetus over the 1990s.
I. Econometric Methodology and Data

Our basic model includes economic activity, prices, interest rates, and broad money. Our measure of economic activity is real private demand (real GDP minus total government spending), because public sector demand is driven primarily by fiscal policy, which is assumed to be exogenous. We express private demand as a ratio to potential output, because it is widely recognized that potential growth in Japan slowed sharply between the 1980s and the 1990s, and we do not want this phenomenon to influence our results—our focus is the impact of monetary events on the cyclical behavior of real private demand. We use the IMF’s measure of potential output, which is based on a Cobb-Douglas production function. (For a discussion of the advantages and disadvantages of this measure, see Bayoumi, 1999.) The price level is given by the natural logarithm of the consumer price index, while real broad money (M2 + CDs) is divided by potential output, so that responses can be easily converted into policy multipliers. The use of potential output to scale real private demand and real broad money is not critical to the results—estimation using the logarithms of activity and money yielded similar results.

Our measure of the stance of monetary policy in Japan is the (uncollateralized) overnight call rate, the current operating target of policy. Although both the instruments and operating objectives of the Bank of Japan have evolved over time, mostly reflecting the development of financial markets, several authors have noted that monetary policy has consistently laid a strong emphasis on short-term interest rates. For example, Okina (1993) states that the Bank of Japan’s policy “always begins with controlling interest rates in short-term money markets.” Other recent work on monetary policy in Japan, such as Kwon (1998) and Ogawa (1999), has also focused on the overnight call rate. Other short-term interest rates, such as the Gensaki (repurchase of government securities) rate, closely track the call rate.

In addition to a constant term and a time trend, the VAR also includes two dummy variables aimed at capturing the short-term shifting of demand seen in the quarter before and the quarter after the introduction of the consumption tax in April 1989 and its increase in April 1997, with each variable designed so that the

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3The inclusion of the real effective exchange rate yields similar results for these variables and plausible results for the exchange rate. Given that Japan—like the U.S.—is a relatively closed economy and that the exchange rate channel is not the focus of this paper, we omit the exchange rate from subsequent models.

4An alternative interpretation is that the multiplier on government spending is unity, a value used in other IMF work (Lipworth and Meredith, 1998), although recent empirical work has pointed to a somewhat lower value (Bayoumi, 1999).

5The data sources are provided in Appendix I. Since activity and money are measured as ratios to potential output, prices are in logarithms, and the nominal interest rate is a ratio, a change of 0.01 represents a 1 percentage point change in the relevant variable.

6For other recent empirical work using this approach, see Bayoumi (1999).

7See also Singleton (1993) and Ueda (1993) in the same volume. Kasa and Popper (1997), who use a structural VAR approach to study the objectives and operating procedures of the BOJ, also conclude that short rates are important.
impacts sum to zero over time. The VAR is estimated with quarterly, seasonally-adjusted data from 1980Q1 to 1998Q3 using two lags—the results are similar when we start the estimation a few years earlier or later, or use different lags.

The VAR is identified using a Choleski decomposition, with the ordering being private demand, prices, the overnight call rate, and broad money. As the reduced-form errors are typically correlated, the Choleski decomposition isolates the underlying structural errors by recursive orthogonalization, with the innovation in the first equation untransformed, the innovation in the second equation taken as orthogonal to the first, and so on. The ordering determines the level of exogeneity of the variables, so current shocks to activity are assumed independent of current shocks to all the other variables in the system, while current shocks to money are assumed to be affected by current shocks to all other variables.

The ordering was chosen on the basis of the speed with which the variables respond to shocks, with output assumed to be the least responsive, followed by prices, then short rates, and finally broad money. Given the time-consuming planning processes involved in setting output and prices, these variables are assumed not to react to contemporaneous shocks to financial variables. The monetary authorities are assumed to set the call rate with information about the contemporaneous behavior of slowly-moving output and prices, but without a full picture of the behavior of quickly-changing financial variables. Broad money—and, in the extended VARs, funding or lending aggregates—are assumed to reflect contemporaneous shocks to output, prices, and monetary policy. Although we did not estimate all possible alternative orderings, the results were similar for some radical re-orderings (in particular, completely reversing the ordering to be money, interest rate, prices, and activity). Alternative orderings are also discussed regularly in the discussion of the extended VARs.

While Choleski decompositions are a common method of identifying a VAR, other methods, which assume two-way contemporaneous feedback between some elements of the VAR, have also been developed. Such methods have been used to help identify monetary VARs of the type we are estimating (using U.S. data), although we did not utilize such an approach for two reasons. First, a survey of the monetary VAR literature by Christiano, Eichenbaum, and Evans (1999) finds considerable agreement about the qualitative effects of monetary policy across a large subset of the identification schemes that have been proposed. Second, the cost of more complex approaches, in which the contemporaneous relationships between variables are more simultaneous, is that the identification scheme becomes more complicated without necessarily becoming less controversial. Given the robustness of our results to relatively radical re-orderings of the underlying variables, we focussed only on Choleski decompositions.

We then extend the VAR in a number of different directions to examine alternative aspects of the monetary transmission mechanism. To analyze the sensitivity of different components of private demand to monetary shocks, we split private demand into its main components: private consumption, business investment, housing investment, and net exports. For each component (say, private consumption), we estimate a VAR with the following ordering: total private demand minus...
the component of interest, the demand component of interest, prices, the overnight call rate, and broad money.

To investigate the role of financial intermediation in the monetary transmission mechanism, we extend the basic VAR by including the main components of private sector funding. Specifically, we add loans received by corporations and individuals from public financial institutions, loans from private financial institutions (essentially bank loans), and funds raised in securities markets. Public financial institutions, such as the Housing Loan Corporation, the Japan Development Bank, and the Finance Corporation for Small Business, support policy objectives by providing subsidized loans. While the supply of public loans is thus partly exogenous, both the demand and supply of public loans also react to shocks to the variables included in our model. We order public loans before securities markets and bank loans on the assumption that bureaucratic processes are generally slower than private sector processes. It turns out that the results are similar for different orderings.

Next, to further examine the role of banks in the monetary transmission mechanism, we incorporate the two main components of bank assets: loans and holdings of securities. Securities holdings are ordered last, reflecting the relative ease with which they can be adjusted. If, as we suspect, shocks to bank assets turn out to be important in causing output variations, how should we think about them, as distinct from interest rate and money shocks? One possibility, suggested by the literature on the credit crunch, is that shocks to bank loans reflect changes in banks’ capital strength (see Ito and Sasaki, 1998, and Woo, 1999). For example, an unexpected improvement in bank strength might cause banks to extend more loans. To test this hypothesis, we add a market-based indicator of bank strength—bank stock prices relative to overall stock prices—to the bank credit VAR.

Finally, we estimate a single VAR that we feel captures the key elements of the monetary transmission mechanism. As business investment turns out to be much more sensitive to monetary shocks than other components of private demand, we run the VAR with private demand split into business investment and the remainder. We then include the other basic variables—prices, overnight call rate, and broad money. As our investigation of the transmission channel from the perspectives of both borrowers (private sector funding) and lender (bank assets) revealed the important role played by bank loans to the private sector, we include this variable.

II. Empirical Results

Basic Monetary Model

The basic model, which includes private demand, prices, interest rates, and money, provides four important results relevant to the monetary transmission mechanism:

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8 The stock price index for the banking sector from the Tokyo Stock Exchange is available starting in 1983, truncating the sample period. The variable is normalized to unity over the sample period, so that changes have the interpretation of percentage deviations. This variable was ordered last in the VAR, given that market prices generally respond quickly to all types of shocks.
A PEEK INSIDE THE BLACK BOX

(i) interest rate shocks have significant effects on real private demand, consistent with an important role for monetary policy; (ii) broad money shocks also have significant effects on output, even though interest rates are included in the model, consistent with the idea that nonpolicy monetary shocks are also important in determining economic activity; (iii) much of the effect of interest rate shocks on output is transmitted through broad money; and (iv) base money has no significant impact on output.

The results from the basic model are illustrated through the model’s impulse response functions reported in Figure 1. An unexpected rise in short-term interest rates causes a statistically significant decline in private demand, which bottoms out after 8–10 quarters. The implied multiplier for the interest rate is minus 0.6, calculated as the ratio of the fall in output (0.3 percent) to a typical interest rate shock (0.5 percent). A broad money shock also causes a significant increase in private demand, with a ¥100 increase in broad money raising real private demand by ¥80. The fact that a money shock has a large impact on economic activity, even when the interest rate is included as a separate variable in the VAR (that is, we control for interest rates), is consistent with the idea that the interest rate channel alone does not fully account for the sources and transmission of monetary shocks in Japan.

The price level responds positively to an interest rate innovation, apparently suggesting that a monetary contraction produces inflation. This latter result is commonly found in the empirical literature on the monetary transmission mechanism in the United States and has been dubbed the “price puzzle.” As noted by Sims (1992), the price puzzle could be a consequence of failing to include a rich enough specification of the information available to policymakers. If policymakers can observe variables that contain useful information about future inflation, but those variables are not included in the model, there will be apparently unpredictable changes in interest rates that are actually systematic responses to information implying that inflation is on the way. Interest rates rise in response to price shocks but are relatively insensitive to private demand shocks, consistent with the BOJ’s emphasis on price stability. The fact that interest rates do not respond to real private demand innovations, but private demand responds negatively to interest rate innovations, suggests that simultaneity in the determination of these variables may not be a serious problem. The combination of positive interest rate and output responses to broad money innovations could reflect the predominance of favorable real shocks that are not

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9 Detailed results for this VAR and the others reported in the paper are contained in Appendix II, including two-standard-error bands around the impulse responses. The analytic asymptotic standard errors are computed according to the formula given in Hamilton (1994, page 339). Similar results were obtained using Monte Carlo standard errors.

10 This multiplier is similar to that obtained by Bayoumi (1999), who uses a VAR methodology with a different set of variables, although only about half of that obtained by Lipworth and Meredith (1998), who use the Japan block of the IMF’s MULTIMOD model, and at the lower end of the range of estimates from large econometric models presented by Krugman (1998).

11 The introduction of commodity prices reduces this source of bias in empirical work on the United States (see, for example, Christiano, Eichenbaum, and Evans, 1996). However, neither commodity prices nor stock prices resolved the price puzzle in Japan.
Figure 1. Japan: Impulse Response Functions for the Basic Model
(Response to one S.D. innovations)

Source: Authors’ calculations.
fully accommodated. Another possible explanation is that money (supply) shocks are indicative of future inflation, consistent with the price level's positive response to money shocks. Finally, broad money responds negatively to interest rate innovations (tighter monetary policy) and price level innovations (adverse aggregate supply shocks), and positively (but not significantly) to real private demand innovations, consistent with standard views on the behavior of money demand.

To get an idea of the share of the fluctuations in a given variable that are caused by different shocks, we calculate variance decompositions for each variable at forecast horizons of one through four years (Table 1). The second column in each sub-table gives the forecast error of the variable for each forecast horizon. The remaining columns give the percentage of the variance due to each shock—each row adds up to 100. The results indicate that, after two years, monetary factors (both interest rate and broad money shocks) account for over half of the fluctuation in private demand, while own shocks account for less than one third of such variance—a significantly lower value than for any other variable in the VAR. Interest rate innovations alone account for about 20 percent of the variance in private demand after two years—similar to empirical results for the U.S. economy. In short, monetary factors appear to be very important determinants of fluctuations in economic activity.

The significant influence of broad money on private demand suggests that it may be an important channel for transmitting changes in interest rates. To examine this issue, we reran the VAR with broad money exogenized, i.e., the lagged values of broad money are treated as exogenous variables in a smaller VAR involving private demand, prices, and the interest rate (Appendix III). Such a procedure generates a VAR identical to the original, except that it blocks off any responses within the VAR which pass through the broad money variable, hence comparisons of the responses of the two models provide a measure of the importance of money in the transmission mechanism. Comparing the two impulse responses of real private demand to interest rate innovations (Figure 2), it is clear that the money supply is an important conduit for the impact of interest rates on real activity.

To examine the interest rate channel more closely, we extended the VAR by adding the interest rate on new bank loans (ordered last). We find that the lending rate responds immediately and strongly to an unexpected change in the overnight call rate. In turn, private demand and broad money respond negatively and significantly to lending rate shocks. These results point to an interest rate channel that originates in the policy interest rate and goes through the bank lending rate and bank balance sheets (including broad money) to affect private demand.

Thus far, we have assumed that monetary policy only acts through interest rates, not through the quantity of high powered money ("quantitative easing"). To address

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12 The source of the forecast error is the variation in current and future values of the innovations to each variable in the VAR.

13 Since broad money is roughly equivalent to the liabilities of the banking system, this result also suggests that banks in particular may play an important role in the transmission mechanism. This is further supported by other results (not reported for the sake of brevity) in which M2 was divided into M1 and quasi-money. The results from this model indicate that it is quasi-money (time and savings deposits) rather than M1 (currency and demand deposits) that primarily affects real demand.
Table 1. Japan: Variance Decompositions for the Basic Monetary Model

(Vin percent)

Variance Decomposition of Private Demand

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Forecast Error</th>
<th>Private Demand</th>
<th>Price Level</th>
<th>Interest Rates</th>
<th>Broad Money</th>
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</thead>
<tbody>
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<td>46.1</td>
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Variance Decomposition of Price Level

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<th>Price Level</th>
<th>Interest Rates</th>
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<td>57.4</td>
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Variance Decomposition of Interest Rates

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<th>Interest Rates</th>
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Variance Decomposition of Broad Money

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<th>Broad Money</th>
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<td>57.9</td>
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</table>

Source: Authors' calculations.

the issue of whether base money is also important for aggregate demand when interest rates are held constant, we added base money to the basic model. The impulse response of real demand to base money is small and insignificant—a typical money base shock raises real private demand by less than 0.1 percent. In addition,

14The equation for base money is ordered second to last (before broad money but after the short-term interest rate to account for the impact of interest rate changes on base money). The results are similar if base money is ordered last.
adding base money has no perceptible impact on either the size or significance of the response of aggregate demand to broad money. This suggests that, at least in normal circumstances, quantitative easing may have only limited effects on activity.

Components of Private Demand

The first experiment we conduct is to examine which components of real private demand are most affected by monetary policy. This is accomplished by rerunning the basic model with real private demand split between the particular component being examined and the remainder of private demand (ordered first to avoid spurious correlations). For business investment, for example, the VAR involves private demand less business investment, business investment, prices, the overnight call rate, and broad money.

Figure 3 shows the response of the individual demand components to a change in interest rates and a change in broad money. The results indicate that monetary policy operates on the real economy largely through its impact on business investment. A typical innovation in the overnight call rate changes business investment by over 0.2 percentage points of potential output after 2½ years, compared to 0.1 percentage points for household spending (the sum of consumption and residential

15The components of private demand being consumption, business investment, residential investment, exports, and imports.
The importance of business investment is consistent with the view that the bank lending channel dominates the investment) and a negligible effect on net exports. The importance of business investment is consistent with the view that the bank lending channel dominates the

Note that the sum of these components—0.3 percent of potential—is very close to the result found for total private demand in the basic model, indicating that the decomposition into separate components of demand is broadly consistent with the aggregate results.
monetary transmission mechanism in Japan, as such investment is largely funded out of bank lending, at least at the margin. Similar results are also found with regard to broad money. Table 2, which reports the variance decompositions for the VAR with business investment, shows that—after two years—monetary factors account for over 50 percent of the fluctuation in business investment.

Private Sector Funding

The second extension to the basic model involves adding the main components of private sector funding: bank loans to corporations and households (hereafter simply called bank loans), loans from government financial institutions to these same sectors (henceforth, public loans), and funds raised by corporations through securities markets. So the VAR comprises (in order) private demand, prices, the overnight call rate, broad money, public loans, funds from securities markets, and bank loans. As discussed further below, the following conclusions emerge: (i) bank loans are both an important conduit for the monetary transmission mechanism and a significant source of independent shocks to private demand, while funds from securities markets and public loans have neither of these characteristics; and (ii) innovations to bank loans elicit no significant response from securities markets or public loans (in other words, there is no effective substitute for bank loans), while increases in public loans are almost entirely offset by subsequent reductions in bank loans and securities markets funding. Public loans substitute for private credit, helping to explain why they have little impact on demand.

The addition of these private sector funding variables has almost no impact on the responses within the basic model, with one important exception, namely that the impact of the overnight rate on demand becomes insignificant (see Appendix II). As this is the main transmission channel for monetary policy in the model, this result would be important if it turned out to be robust. Further investigation indicates, however, that this result is reversed when the series measuring funds raised in securities markets is eliminated from the VAR. As this variable has very little impact on the rest of the model, and this is the only case in which our monetary VARs produce an insignificant interest rate response on output, we view this effect as a statistical aberration.

Turning to the results for the three additional variables, the impulse responses indicate that innovations to bank loans unconnected with interest rates and activity have a large and significant impact on private demand, with a ¥100 increase in bank loans leading to a ¥50 increase in real demand (Figure 4). By contrast, independent increases in funds from securities markets or public loans have no significant impact on demand. In the case of securities markets, this appears to reflect their limited importance in financial intermediation (comparing the size of own responses, the typical innovation to credit from securities markets is only two-fifths that of bank loans). For public loans, which are a more important component of the financial transmission mechanism, the results show that a rise in public

17These data come from the flow of funds accounts. The securities markets series aggregates funds from bonds, corporate paper, and equities.
## Table 2. Japan: Variance Decompositions for the Business Investment Model

*In percent*

### Variance Decomposition of Private Demand Minus Business Investment

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Forecast Error</th>
<th>Other Activity</th>
<th>Business Investment</th>
<th>Price Level</th>
<th>Interest Rates</th>
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### Variance Decomposition of Business Investment

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### Variance Decomposition of Price Level

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### Variance Decomposition of Interest Rates

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### Variance Decomposition of Broad Money

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</table>

Source: Authors’ calculations.
loans is followed by reduction in privately-sourced funds. Furthermore, these results are similar if different orderings of the three additional variables are used.

Figure 5 shows how the three new variables respond to each other, in other words, the degree of substitution between different forms of private sector funding. As can be seen in the bottom panel of the figure, an increase in bank loans elicits no significant response from either securities markets or government financial institutions, implying that shocks to bank credit translate almost one-for-one into lower borrowing by the private sector. By contrast, as can be seen in the top panel, an increase in public loans is offset quite rapidly by reductions in bank loans and credit from securities markets—public loans are generally a substitute for private funds, not an addition to them. This very different set of responses helps to explain why bank loans have a direct impact on demand, but public loans do not. Table 3 presents the variance decompositions, which show that bank loans account for about 10 percent of the fluctuation in private demand after two years.

The role of different sources of funds in the monetary transmission mechanism was explored by rerunning the VAR with each of the funding variables being exogenized in the same manner that broad money was exogenized earlier, so that any responses involving these variables are eliminated. Exogenizing bank loans leads to a dramatic reduction in the impact of broad money on private demand, while exogenizing funds from securities markets and public sector loans produces almost no change in this money effect, indicating that bank loans are the main transmission mechanism of monetary disturbances to the real economy.¹⁸

¹⁸Responses of short-term interest rates are not reported as they were small and insignificant in the main model, as discussed earlier.
Figure 5. Japan: Substitution Between Sources of Funding
(Response to one S.D. innovations)

Responses to a Shock to Public Loans

Responses to a Shock to Capital Market Funding

Responses to a Shock to Bank Loans

Source: Authors' calculations.
### Table 3. Japan: Variance Decompositions for the Private Sector Funding Model

#### (In percent)

**Variance Decomposition of Private Demand**

<table>
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<th>Private Demand</th>
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**Variance Decomposition of Price Level**

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**Variance Decomposition of Interest Rates**

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**Variance Decomposition of Broad Money**

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**Variance Decomposition of Public Loans**

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Table 3. (concluded)

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Variance Decomposition of Bank Loans

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Source: Authors’ calculations.

Bank Lending

This section further examines the role of banks in the monetary transmission mechanism by adding to the basic model the main components of bank assets, namely loans and holdings of securities. Including banks’ balance sheets in the analysis yields the following insights into the monetary transmission mechanism in Japan: (i) shocks to bank loans have a positive and significant effect on private demand, even controlling for interest rates and broad money; (ii) the impulse responses of private demand to interest rate and money shocks are reduced when bank loans are exogenized, suggesting that bank loans are an important transmission channel; and (iii) the addition of relative bank stock prices to the VAR suggests that bank loan shocks may largely reflect innovations to bank strength.

The bank lending VAR includes private demand, prices, interest rates, broad money, bank loans, and banks’ holdings of securities. The impulse responses for the basic model variables are generally similar to the results reported previously, with the overnight call rate having a significantly negative effect—and broad money a significantly positive effect—on private demand (see Appendix II). The response of private demand to a broad money shock is somewhat smaller than that in the basic model, suggesting that part of the broad money shocks in the basic model reflect bank lending shocks (top panel of Figure 6). Turning to the impact of the additional variables on private demand, a shock to bank lending credit has a positive and long-lasting effect—a ¥100 increase in bank lending increases private demand by almost ¥50—while shocks to securities have little short-term impact (middle panel of Figure 6). The variance decompositions (Table 4) also
Figure 6. Japan: Impulse Responses for Bank Lending Model
(Response to one S.D. innovations)

Responses of Private Demand to Money Shock

Responses of Private Demand

Responses to Broad Money Shocks

Source: Authors' calculations.
show that the addition of bank loans to the VAR reduces the fluctuation in private demand that is accounted for by broad money shocks.

Bank loans and securities both respond negatively to an interest rate shock and positively to a money shock (bottom panel of Figure 6).\(^\text{19}\) The fact that the immediate reactions of bank loans and securities are so large, accounting for more than four-fifths of the shock to broad money, shows that a shock to the main component of bank funding (broad money) cannot be immediately offset with a change in other liabilities. In turn, this suggests that banks do not face a perfectly elastic supply of funds and thus need to make an immediate adjustment in assets. Our results show that bank loans and securities respond in similar ways to monetary shocks, which is not consistent with the idea that banks use their relatively liquid

\(^{19}\)When the VAR is run without broad money, the impulse responses of private demand to innovations in bank loans and securities are somewhat larger, consistent with the view that these variables to some extent capture money shocks.
assets (securities) as a temporary shock absorber and adjust their loans over the
longer run, as they do in the United States.20

The role of bank loans in the transmission mechanism can be further exam-
ined by exogenizing bank loans in the calculation of the impulse responses. Exogenizing bank loans sharply dampens the impulse response of private demand
to both interest rate and broad money shocks (Figure 7). Our results suggest that,
after two years, about two-thirds of the direct impact of a change in the overnight
call rate on private demand comes through bank loans. By contrast, exogenizing
securities holdings does not have these effects. These results indicate that bank
loans play an important role in transmitting interest rate and money shocks to
economic activity.

Given the importance of bank loans in determining activity, it is useful to try
to identify the nature of loan shocks, as distinct from interest rate and money
shocks. Motivated by the idea that bank weaknesses could be pushing banks to

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contract lending (a credit crunch), we considered a market-based measure of bank strength, namely the relative value of bank stocks to the overall TOPIX. When added to the VAR, this variable does a good job of anticipating movements in bank loans, and otherwise generates the anticipated pattern of responses. The impulse response of private demand to bank strength is positive and significant. While private demand still responds positively and significantly to a shock to bank loans,

21Balance-sheet-based measures of bank strength, such as a bank’s reported capital adequacy ratio, are suspect. For example, Long-Term Credit Bank reported a capital adequacy of over 10 percent for March 1998, just a few months before it was found to have negative net worth equivalent to over 14 percent of risk assets.
the size of the response is now smaller. The responses of private demand to interest
rate and money shocks are smaller, indicating that part of the impact of such
shocks is captured by the measure of bank strength. While it is possible that banks
are particularly sensitive to private sector shocks, so a decline in their relative
value just reflects real developments, this sensitivity is already taken into account
by ordering bank strength last in the VAR, that is, shocks to bank strength are
orthogonal to private demand, prices, and money.

An interesting application of these results is to assess the likely impact of the
recent decision to inject public funds into major banks on private credit and real
demand. In the wake of the enactment of bank legislation in October 1998, which
established the framework for the capital injections that eventually occurred in
March 1999, bank stock prices recovered strongly—the bank strength variable
rose by about 5 percentage points between the third and fourth quarters of 1998.
In terms of the history of this variable, such an improvement is equivalent to a
typical (one standard deviation) shock to bank strength. If we attribute this
improvement exclusively to a previously unanticipated change in expectations
about public capital injections, the estimated results suggest that bank loans will
be about 0.5 percent of GDP higher than otherwise after about one year (and
private demand about 0.35 percent of GDP higher).

Summary Model

We now run a single VAR that summarizes our key findings about the role of
banks in the monetary transmission mechanism, namely that banks are both a
significant source of independent shocks to private demand and an important
conduit for interest rate and broad money shocks. The summary VAR differs from
the basic model in two crucial aspects. First, reflecting the particular sensitivity of
business investment to monetary shocks, the summary VAR splits private demand
into business investment and the remainder of private demand. Second, the
summary VAR adds bank loans (ordered last).

The impulse responses of this model show that shocks to interest rates, broad
money, and bank loans all have large and significant effects on business invest-
ment and the remainder of private demand (Figure 8 and Appendix II). The reac-
tions to these shocks of business investment and the remainder of private demand
differ in two important ways: (i) the reactions of business investment are two to
three times larger, confirming that this component of private demand is particu-
larly sensitive to monetary shocks; and (ii) the reaction to any given shock of
business investment builds up more slowly than the reaction of the remainder of
private demand, reaching their peaks about one to two years later, which is
consistent with the idea that planning processes for business investment are
longer than for other components of private demand. The variance decomposi-
tions (Table 5) confirm that, after two years, the fraction of the fluctuation in
business investment accounted for by monetary factors is larger than that for the
remainder of private demand.

The fact that shocks to bank loans have positive and significant effects on
private demand, even controlling for interest rates and broad money, confirms that
banks play an important independent role in the monetary transmission mechanism. This role of banks as lenders is distinct from that played by the monetary authorities (who determine the overnight call rate) and economic agents more broadly (who decide their demand for money). The fact that the impulse responses of private demand to interest rate and money shocks are reduced when bank loans are exogenized confirms that such shocks are transmitted—at least in part—through bank loans, suggesting an important role for a bank lending channel.

Finally, we use the results of the summary VAR to decompose the actual path of business investment from 1980 to 1998 into the part predicted by the exogenous...
### Table 5. Japan: Variance Decompositions for the Summary Model

#### (In percent)

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<th>Quarter</th>
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#### Variance Decomposition of Business Investment

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#### Variance Decomposition of Price Level

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<th>Other Activity</th>
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variables (constants, time trends, and dummies) and the remainder (the shock). This total shock is then divided into the part explained by innovations in financial variables (overnight call rate, broad money, and bank loans) and that explained by innovations in “real” variables (remainder of private investment, business investment, and prices). The historical decomposition in Figure 9 shows quite nicely how the bubble in the late 1980s was driven by both real factors (including animal spirits) and financial shocks, while the recession of the early 1990s reflected the reversal of both these sets of shocks. Conversely, the pickup in business investment in 1996–97, which helped Japan achieve the most rapid growth rate among OECD countries in 1996, was driven exclusively by real factors, with financial shocks remaining in negative territory. Similarly, the recent abrupt decline in business investment reflects a reversal of these real factors, possibly owing to adverse effects of the Asia crisis on confidence.²²

²²The results of the decomposition are similar if the VAR is reordered with the financial variables preceding the real variables.
Table 5. (concluded)

Variance Decomposition of Interest Rates

<table>
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<tr>
<th>Quarter</th>
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<th>Bank Loans</th>
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</tr>
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Variance Decomposition of Broad Money

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<th>Other Activity</th>
<th>Business Investment</th>
<th>Price Level</th>
<th>Interest Rates</th>
<th>Broad Money</th>
<th>Bank Loans</th>
</tr>
</thead>
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Variance Decomposition of Bank Loans

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<th>Other Activity</th>
<th>Business Investment</th>
<th>Price Level</th>
<th>Interest Rates</th>
<th>Broad Money</th>
<th>Bank Loans</th>
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<tbody>
<tr>
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<td>17.8</td>
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</table>

Source: Authors' calculations.

Figure 9 also shows the individual components of the financial shocks to business investment: the interest rate shock, the broad money shock, and the bank loans shock. It is interesting that, at least according to our decomposition, interest rate policy was not surprisingly expansionary during the late 1980s—rather, the bubble was driven by money and loan shocks (possibly reflecting irrational exuberance). The sharp swings in money demand in the early 1990s are difficult to explain, but could reflect in part the public’s initial rush into bank deposits (accompanying the collapse of asset prices) followed by the realization that banks themselves were in difficulties. Although monetary policy has recently provided some support to private demand, the public’s confidence in bank deposits (money demand) and banks’ willingness to lend (bank loans) remain weak, underlying the urgency of further progress on bank restructuring.
III. Conclusions

This paper has used a series of VARs to examine the transmission of monetary shocks to real activity—the so-called black box—in Japan. Starting from a relatively simple specification which describes the overall mechanism, the role of the components of private demand, private sector funding, and bank lending were examined in turn by including relevant additional variables. Finally, a summary VAR was estimated which captures our main findings. The results of these exercises point to a transmission mechanism dominated by banks, in which bank
lending is both an important independent source of shocks and an important conduit for the transmission of interest rate and broad money shocks to real activity. According to our results, after two years about two-thirds of the direct impact of a change in the overnight call rate on private demand comes through bank loans, and that of this change in private demand about two-thirds comes through business investment. In a further experiment, we found that changes in the monetary base had relatively limited effects on real private demand, suggesting that in normal circumstances quantitative easing may provide limited benefits to activity.

The importance of bank loans in financial intermediation appears to reflect the lack of alternative sources of borrowing for much of the nonfinancial private sector, with neither securities markets nor loans from government financial institutions providing a significant offset to changes in bank loans. In addition, independent disturbances to bank credit also appear to have a significant impact on private demand, and much of this effect can be captured by a measure of bank strength based on equity prices. By contrast, the potential benefits from increased loans by the public sector are negated by offsetting decreases in private sector credit.

The important independent role of bank loans in determining activity points to the fact that banking strains may have undermined the monetary transmission mechanism over the last few years. To the extent that banks have responded to their own difficulties by reducing their loans to the private sector, such behavior will have tended to offset the benefits of monetary easing. Indeed, the historical decomposition of the summary VAR shows that, while unanticipated monetary loosening has had a positive effect on business investment recently, shocks to bank loans have dragged down business investment, especially since 1996. We argue that bank weaknesses explain a large part of the negative shocks to bank loans.

Looking to the future, the increasing role of private securities markets in financial intermediation likely to be created by the Big Bang financial deregulation initiative may well reduce the central role of banks in Japan’s financial system, although such changes are likely to be gradual rather than rapid, particularly given the importance of small companies in Japan’s industrial structure. In the meantime, the results from this paper suggest that restoring the banking system to full health should be an important component of any strategy to support activity through monetary policy.

APPENDIX I
Data Sources

Bank strength: Tokyo Stock Exchange (First Section) banking sector index divided by composite index (TOPIX).
APPENDIX II
Impulse Response Functions of Models

Figure A1. Japan: Impulse Response Functions for the Basic Model
(Response to One S.D. Innovations ± 2 S.E.)

YP = Private demand
OCR = Overnight call rate
CPI = Consumer price index
M2 = Broad money
Figure A2. Japan: Impulse Response Functions for the Private Sector Funding Model
(Response to One S.D. Innovations ± 2 S.E.)

YP = Private demand  CPI = Consumer price index  OCR = Overnight call rate
PGFI = Loans from government financial institutions  M2 = Broad money
CM = Capital market financing  PBKPV = Loans from private banks

Response of YP to YP  Response of YP to LOG(CPI)  Response of YP to OCR  Response of YP to M2  Response of YP to PGFI  Response of YP to CM  Response of YP to PBKPV

Response of LOG(CPI) to YP  Response of LOG(CPI) to LOG(CPI)  Response of LOG(CPI) to OCR  Response of LOG(CPI) to M2  Response of LOG(CPI) to PGFI  Response of LOG(CPI) to CM  Response of LOG(CPI) to PBKPV

Response of OCR to YP  Response of OCR to LOG(CPI)  Response of OCR to OCR  Response of OCR to M2  Response of OCR to PGFI  Response of OCR to CM  Response of OCR to PBKPV

Response of M2 to YP  Response of M2 to LOG(CPI)  Response of M2 to OCR  Response of M2 to M2  Response of M2 to PGFI  Response of M2 to CM  Response of M2 to PBKPV
Figure A2. (concluded)
(Responsiveness to One S.D. Innovations ± 2 S.E.)
YP = Private demand   CPI = Consumer price index   OCR = Overnight call rate   M2 = Broad money
PGFI = Loans from government financial institutions   CM = Capital market financing   PBKPV = Loans from private banks

Response of PGFI to YP
Response of PGFI to LOG(CPI)
Response of PGFI to OCR
Response of PGFI to M2
Response of PGFI to PGFI
Response of PGFI to CM
Response of PGFI to PBKPV

Response of CM to YP
Response of CM to LOG(CPI)
Response of CM to OCR
Response of CM to M2
Response of CM to PGFI
Response of CM to CM
Response of CM to PBKPV

Response of PBKPV to YP
Response of PBKPV to LOG(CPI)
Response of PBKPV to OCR
Response of PBKPV to M2
Response of PBKPV to PGFI
Response of PBKPV to CM
Response of PBKPV to PBKPV
Figure A3. Japan: Impulse Response Functions for the Bank Lending Model
(Response to One S.D. Innovations ± 2 S.E.)

YP = Private demand  CPI = Consumer price index  OCR = Overnight call rate  M2 = Broad money
LOAN = Bank loans  SEC = Banks' holdings of securities

Response of YP to YP  Response of YP to LOG(CPI)  Response of YP to OCR  Response of YP to M2
Response of YP to LOAN  Response of YP to SEC

Response of LOG(CPI) to YP  Response of LOG(CPI) to LOG(CPI)
Response of LOG(CPI) to OCR  Response of LOG(CPI) to M2
Response of LOG(CPI) to LOAN  Response of LOG(CPI) to SEC

Response of OCR to YP  Response of OCR to LOG(CPI)
Response of OCR to OCR  Response of OCR to M2
Response of OCR to LOAN  Response of OCR to SEC
A PEEK INSIDE THE BLACK BOX

(Response to One S.D. Innovations ± 2 S.E.)

YP = Private demand  CPI = Consumer price index  OCR = Overnight call rate  M2 = Broad money
LOAN = Bank loans  SEC = Banks' holdings of securities

Response of M2 to YP  Response of M2 to LOG(CPI)  Response of M2 to OCR  Response of M2 to M2  Response of M2 to LOAN  Response of M2 to SEC
Response of LOAN to YP  Response of LOAN to LOG(CPI)  Response of LOAN to OCR  Response of LOAN to M2  Response of LOAN to LOAN  Response of LOAN to SEC
Response of SEC to YP  Response of SEC to LOG(CPI)  Response of SEC to OCR  Response of SEC to M2  Response of SEC to LOAN  Response of SEC to SEC

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Figure A4. Japan: Impulse Response Functions for the Summary Model

(Response to One S.D. Innovations ± 2 S.E.)

YP-BI = Private demand minus business investment  BI = Business investment  CPI = Consumer price index
OCR = Overnight call rate  M2 = Broad money  LOAN = Bank loans

Response of YP-BI to YP-BI  Response of YP-BI to BI  Response of YP-BI to LOG(CPI)  Response of YP-BI to OCR  Response of YP-BI to M2  Response of YP-BI to LOAN

Response of BI to YP-BI  Response of BI to BI  Response of BI to LOG(CPI)  Response of BI to OCR  Response of BI to M2  Response of BI to LOAN

Response of LOG(CPI) to YP-BI  Response of LOG(CPI) to BI  Response of LOG(CPI) to LOG(CPI)  Response of LOG(CPI) to OCR  Response of LOG(CPI) to M2  Response of LOG(CPI) to LOAN
Figure A4. (concluded)
(Response to One S.D. Innovations ± 2 S.E.)

YP-BI = Private demand minus business investment
BI = Business investment
CPI = Consumer price index
OCR = Overnight call rate
M2 = Broad money
LOAN = Bank loans

Response of OCR to YP-BI
Response of OCR to BI
Response of OCR to LOG(CPI)
Response of OCR to OCR
Response of OCR to M2
Response of OCR to LOAN

Response of M2 to YP-BI
Response of M2 to BI
Response of M2 to LOG(CPI)
Response of M2 to OCR
Response of M2 to M2
Response of M2 to LOAN

Response of LOAN to YP-BI
Response of LOAN to BI
Response of LOAN to LOG(CPI)
Response of LOAN to OCR
Response of LOAN to M2
Response of LOAN to LOAN
APPENDIX III
Exogenizing a Variable

Consider the three-variable VAR:
\[ x_t = \alpha_1 x_{t-1} + \beta_1 y_{t-1} + \gamma_1 z_{t-1} \]
\[ y_t = \alpha_2 x_{t-1} + \beta_2 y_{t-1} + \gamma_2 z_{t-1} \]
\[ z_t = \alpha_3 x_{t-1} + \beta_3 y_{t-1} + \gamma_3 z_{t-1} \]

We exogenize the variable \( z \) by running a two-variable VAR with \( z \) as an exogenous variable:
\[ x_t = \alpha_4 x_{t-1} + \beta_4 y_{t-1} + \gamma_4 z_{t-1} \]
\[ y_t = \alpha_5 x_{t-1} + \beta_5 y_{t-1} + \gamma_5 z_{t-1} \]

This procedure generates a VAR in which the first two equations are identical to the original VAR. However, the impulse response functions will be different because any interaction between these variables that passes through \( z \) will be blocked (because it is exogenous). Hence, comparisons of the two sets of impulse response functions provides a measure of the importance of the variable \( z \) in the transmission mechanism.

REFERENCES


A PEEK INSIDE THE BLACK BOX


Recapitalizing Banks with Public Funds

CHARLES ENOCH, GILLIAN GARCIA, and V SUNDARARAJAN

Recapitalizing banks in a systemic crisis is a complex medium-term process that requires significant government intervention and careful management at both the strategic and individual bank levels. This paper examines the range of operational and strategic issues involved and the institutional arrangements needed to foster an effective banking system restructuring, as well as maximize the returns on government investment. Recapitalization approaches have varied in the different mixes of direct capital injections and asset purchases and rehabilitation that countries choose. The choice of an appropriate mix is critical to minimizing the expected present value of government outlays net of recoveries. [JEL G1, G21, G32, H81, O16]

Consider the following scenario: a banking crisis has erupted and has begun to intensify and spread. In response, the government decides to restructure and recapitalize the banks in order to overcome the negative effects of a dysfunctional banking system on economic growth and wealth. This decision is taken because weaknesses in the financial system and extreme uncertainty that prevails during the crisis have limited private capital, and the government fears that banks will fail in large numbers. It hopes that the injection of public funds to strengthen bank capital, together with additional financial and operational restructuring of banks, will restore public confidence in the banking system, reduce uncertainty,

*This paper was written with help from colleagues in the IMF’s Monetary and Exchange Affairs Department and able research assistance from Elena Budreckaite. The paper benefited from the comments of Stanley Fischer, Stefan Ingves, and Carl-Johan Lindgren. An earlier draft was reviewed by Charles Adams, Bijan Aghevli, Peter Heller, and Leslie Lipschitz of the IMF; and Jonathan Fiechter, Larry Promisel, and Thomas A. Rose of the World Bank. The authors are also grateful for comments from two anonymous referees.
accelerate resolution of the banking crisis, and promote economic recovery through reestablishing banking and payment services, and ensuring that viable businesses can fund their operations. From 1994 to 1999 these circumstances confronted a number of countries in Asia, Central and Eastern Europe, the former Soviet Union (FSU), and the Americas.

In systemic bank restructuring, public funds may be needed to (1) make payouts to depositors of closed banks; (2) compensate banks that agree to accept deposit transfers; (3) facilitate an acquisition, merger, or purchase and assumption; (4) help recapitalize banks; and (5) restructure assets. This paper focuses specifically on operational and technical issues that relate to the last two items: the granting of assistance through capital injections and asset rehabilitation to facilitate the continued operation of banks that are to be kept open. The paper examines, in sequential order, the choices that must be made and the steps that have to be taken to implement the decisions. The discussion draws on the experiences of five Asian countries, Mexico, Sweden, and the United States.

For many of the issues covered in this paper there is no single practice that is clearly superior based on theoretical or analytical grounds. Decisions must be taken case by case, and often they are based on specific institutional factors—such as the legal system of the country or the availability of skilled resources to manage problem assets. Drawing on the experiences of select countries, this paper seeks to identify the important factors influencing the decisions in such trade-offs, as well as the best practices that should be adopted given whichever choice the authorities make.

I. Bank Restructuring Agency: Organizational Issues

Our analysis starts at the point where the government intervenes in a banking/currency crisis by using public funds for bank recapitalization. Before reaching this point the government should have made a preliminary estimation of the costs of restoring a functional banking system. The government should have formulated an overall strategy for bank restructuring, encompassing the following key elements: (1) diagnosis; (2) triage; (3) prompt exit of nonviable banks; (4) a well-designed recapitalization strategy for viable and essential banks; (5) operational restructuring of banks; (6) efficient management and recovery of nonperforming assets, supported by loan workouts; (7) equitable loss-sharing arrangements and containment of public sector costs; and (8) a strengthening of prudential supervision of banks to prevent further accumulation of losses.

1The paper does not discuss in detail certain related matters, such as the rationale for the use of public funds, the deposit insurance agency (DIA), the need for, and methods of, taking legal recourse against criminal acts, and corporate restructuring. More in-depth discussions of forbearance, asset management corporations, and lender of last resort facilities are presented in other papers.

2The design and sequencing of bank restructuring and prudential supervision reforms, taking into account their macroeconomic impact, are discussed in Alexander and others (1997), and Sundararajan (1999).

3See Appendix I for a definition of the term.

4The form of resolution for a problem bank—closure and liquidation, partial or complete merger, temporary "bridge bank," or support to keep the bank operating—depends upon the bank's governance, its financial condition, and its franchise value.
Of course, a key limitation on the government’s plans for intervention is the amount of public funds it has available. However, an equally fundamental constraint is the availability of human resources, which will influence the organizational structures used in the intervention. These constraints may be more binding in some countries than in others.\(^5\)

Putting a recapitalization strategy into operation will frequently require legal and institutional changes, including the possible creation of public bodies, such as a bank restructuring agency (BRA) to oversee the comprehensive restructuring strategy. The BRA establishes the principles by which some banks are selected for closing and others for recapitalizing and restructuring. The BRA may have two key components or subsidiaries: a bank support authority (BSA) that holds equity, and in some cases may lend to safeguard the value of its equity holdings; and one or more asset management companies (AMCs)\(^6\) that manage and restructure the assets taken from intervened banks, and buy bad loans and dispose of them.\(^7\) In the case of Sweden, authorities created an oversight board for the BRA, with separate AMCs as subsidiaries. Sweden, which has a relatively developed financial system with considerable operating experience in a market environment, nevertheless encountered shortages of financially skilled labor to run these organizations. In other situations, such as in transition economies, a simpler structure with clear lines of authority and accountability may be more appropriate.

The authorities must make a number of organizational decisions relating to the BRA. The first is whether to use existing agencies or create a new organization—to oversee recapitalization and restructuring, take control of funds that have already been committed, make and manage additional investments in banks, and later sell them cost-effectively.\(^8\) Where a deposit insurance agency (DIA) is already in place and can be expected to competently manage the crisis, it may be augmented to handle the challenge, but such a situation is relatively unusual. Often there is no DIA; in some cases the existing DIA is blamed for allowing banking problems to deteriorate into the current crisis; and, typically, the magnitude of the crisis is so grave that a new agency is needed.\(^9\)

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\(^5\)The government should appoint independent, professionally competent executives and boards to manage banks that are taken over. If it proves difficult to find such individuals, the use of international bankers, accounting firms, and investment bankers becomes critical to fill part of the human resources gap. Otherwise, human resource constraints may influence the design of the restructuring and recapitalization program, and place a premium on identifying economies of scale in resolving banks, and on efficient clustering of banks.

\(^6\)See Nyberg (1997).

\(^7\)In the early stages of a bank restructuring process, provision of proper information to the public helps to restore confidence, and such information will include a brief description of the organizational structure that will be established to manage the bank restructuring and the legislative changes necessary to set up the BRA and to grant it powers to successfully discharge its responsibilities.

\(^8\)See Nyberg (1997).

\(^9\)Indonesia, Malaysia, and Thailand have no DIA and thus required a special agency. Although Korea has an existing DIA, it also created a special agency to handle its bank problems. During the bank and thrift problems of the late 1980s and early 1990s in the United States, the Bank Insurance Fund (BIF) was judged able to handle the banking problems and resolved 1,394 failed banks between 1984 and 1992. The thrift regulator and insurer, however, were replaced by a new regulator, and a special temporary agency, the Resolution Trust Corporation (RTC), was created to manage the crisis (Alexander and others, 1997, pp. 86–91).
The second decision is whether to make the agency independent or an integral part of the government. The agency in charge of restructuring will need clear legal authority to determine—using universally applied and transparent criteria—which banks should receive public capital assistance and which should not. The agency should be autonomous to make and implement resolution decisions, and also be held accountable for its actions. After decisions are implemented, they need to be made transparent and explained thoroughly. No governments give full independence to a BRA where a large percentage of GDP is devoted to recapitalizing banks. Accountability to parliament in most countries is achieved through a ministry. The Ministry of Finance (MOF), as guardian of the public purse, is a typical choice among government agencies to manage restructuring. The central bank or an independent bank supervisor are also possibilities. Government agencies, however, are not usually involved in the day-to-day business of running banks, and when they attempt to do so, the arrangement has frequently not been very effective because of governance problems. Consequently, while it is appropriate that the government’s interest in the success of the BRA’s operations be explicitly recognized in the agency’s organizational structure, it should also protect the operating units from political interference in the day-to-day operations, and make them to be functionally independent, and publicly accountable.

While there are several ways to achieve a compromise between accountability and independence, one institutional model for bank restructuring is shown in Figure 1. Within this framework, the BRA is an agency subordinate to the MOF and separate from an independent central bank, the supervisory agency, and the DIA. It is wise not to place the BRA within the central bank, so as to avoid incentives to finance restructuring through money creation. It can also be argued that the supervisory agency should not run the BRA because it has no sources of finance and may be tempted to give preferential supervisory treatment to banks that it owns. Moreover, while the DIA could handle nonsystemic banking failures, it lacks the financial and human resources and the authority to deal successfully with a systemic crisis.

Most countries find a need for an overarching board to liaise with other parts of the government, and to coordinate and supervise subsidiaries’ activities. The MOF and the central bank should be represented on the BRA’s oversight board together with the agency’s chief executive officer (CEO), and a number of knowledgeable and independent members of the public. The composition of such a

10In Figure 1 the supervisory agency is shown within the central bank. An alternative diagram could show the supervisory agency as a separate institution.

11Indonesia and Thailand placed their BRAs subordinate to their ministries of finance. In Malaysia, the BRA is run by the central bank, which is only quasi-independent of the MOF. Korea’s BRA is a subsidiary of its independent supervisory agency. Japan and Mexico have involved their DIAs to some extent in bank restructuring and recapitalization. The United States created an independent agency, the RTC, to handle failed thrifts, but not failed banks. (However, the RTC spent a smaller percentage of GDP—roughly 2 percent of GDP in the mid-1990s—on failed thrifts than the countries considered in this paper incurred in restructuring their banking systems.) Stylized models of actual experiences in various countries are shown in Figures Al through A8, in Appendix II.

12If the supervisory agency is outside the central bank, one may well wish to have a representative of the supervisory agency on the BRA’s oversight board.
board would be an acceptable compromise between including all interested parties or confining membership to too small a number. In cases where the supervisory agency or the DIA is not formally represented on the oversight board, they would need to maintain close relations with its operational arms. The supervisor must keep the BRA informed on the condition of banks, especially those that are deteriorating and close to closure or recapitalization.

The relationship of the DIA to the BRA depends in part on the breadth of the DIA's past role. In cases where its role was limited to compensating depositors of failed banks, that function may be temporarily overridden by a comprehensive guarantee, which is funded by the government and may fall to the BRA to execute. In other cases where the DIA acted as the receiver/liquidator of failed banks, one of many organizational possibilities is that its responsibilities are temporarily taken over by the BRA with the DIA staff reassigned there, while the DIA is temporarily a subsidiary of the BRA. These possible relationships are shown for selected countries in Figures A1 through A8 in Appendix II.

The responsibilities of the oversight board are to plan the restructuring and recapitalization exercises, assess the appropriate level of fiscal resources for restructuring and recapitalization, and strike a balance between these needs and the fiscal constraints faced by the government. It must not only liaise with the government, but also insulate its operational subsidiaries from political pressure, and keep the public informed of the agency's plans and its progress toward achieving them. Transparency should be a goal and it would be increased through auditing the BRA (at least annually), designing appropriate accountability and disclosure arrangements, and requiring reporting to parliament in public hearings.
Details of the institutional structures that have been established in six countries in order to handle bank restructuring are shown in Table 1.

II. The Bank Restructuring Agency: Terms and Conditions for Assistance

The BRA needs to observe several broad principles when using public funds to recapitalize banks and administer restructuring plans. First, the strategy must hold owners of a failing bank responsible for losses, and make managers accountable for their actions. An incentive structure for both the public and the private sectors that discourages a recurrence of banking problems needs to be put into place. Second, the industrial structure of the rehabilitated banking system must provide core banking services and must be based on the desirable long-term structure of the financial services industry. Third, the end strategy should convert the government’s investments back into cash and return the banking sector to private control. Fourth, the BRA must take control of public funds that have already been spent, for example, by converting into equity the lender-of-last-resort assistance that the central banks, in a number of countries, gave to illiquid and insolvent institutions that were to be recapitalized. Fifth, the restructuring strategy should strive to minimize the amount of public funds used (expenditures net of recoveries) to achieve the objectives of restructuring, and ensure that these funds are dispensed in an efficient, equitable, and cost-effective manner, and that the government obtains securities in some form that support its right to future repayment in exchange for its investment.

In addition to providing finance directly to recapitalize the bank, the BRA must also make a judgment about how much of the bank’s impaired assets should be taken off the bank’s books (e.g., transferred or sold to a separate unit, such as an asset management company) so that the assets can be managed separately. Separation of these assets can help to normalize bank operations and maximize asset recovery, thereby improving the yield on funds invested in bank capital. When the problem bank is fully taken over and controlled by the government, this typically involves transferring an appropriate volume and type of assets to a separate AMC controlled by the government or the BRA. In some situations, the government finances only a part of banks’ capital needs, with the private sector providing the rest and sharing ownership, while at the same time, it assists banks with purchases of some of the impaired assets (for example, by acting through an AMC owned or controlled by the government or the BRA); in these cases, the appropriate allocation of budgetary funds between direct recapitalization and financing (or facilitating) asset purchases becomes an issue. These decisions involve a number of considerations, including the degree of insolvency and

13 For example, Thailand converted Financial Institutions Development Fund (FIDF) support into equity.
14 Central banks rank a failed bank’s assets according to whether they hold collateral against their loans to the bank and the quality of that collateral.
Table 1. Government Agencies Associated with Bank Recapitalization

<table>
<thead>
<tr>
<th>Agency Type</th>
<th>Indonesia</th>
<th>Japan</th>
<th>Korea</th>
<th>Malaysia</th>
<th>Mexico</th>
<th>Thailand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank Support Authority (BSA) (the recapitalization unit)</td>
<td>IBRA itself is the Bank Support Authority.</td>
<td>Existing DIA, with the approval of the CMC/FRC.</td>
<td>Existing: Korean Deposit Insurance Corporation (KDIC).</td>
<td>Danamodal: A government agency that is a subsidiary of Bank Negara.</td>
<td>FOBAPROA administered the PROCAPTE recap program; it has now been replaced by IPAB.</td>
<td>(1) Financial Institutions Development Fund (FIDF) has capital for intervened banks and liquidity for open banks; (2) new FRAC.</td>
</tr>
</tbody>
</table>

Note: See also appendixes for definitions.
<table>
<thead>
<tr>
<th>Agency Type</th>
<th>Indonesia</th>
<th>Japan</th>
<th>Korea</th>
<th>Malaysia</th>
<th>Mexico</th>
<th>Thailand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset Management Company (AMC)</td>
<td>New: Asset Management Unit (AMU), a division of IBRA.</td>
<td>Resolution &amp; Collection Corp. (RCC), includes the Resolution and Collection Bank (RCB) and the Housing Loan Administration Corporation (HLAC); buys bad loans from any bank.</td>
<td>(1) Korean Asset Management Corporation (KAMCO) since 1962; (2) new: Bridge Bank to deal with the good assets of closed merchant banks.</td>
<td>Danaharta: a government company that is owned by the MOF, and is expected to have a life span of 5 to 10 years.</td>
<td>(1) FOBAPROA; (2) Valuación y Venta de Activos (VVA) to appraise and dispose of assets acquired by FOBAPROA; (3) trust funds for bank loan workouts; (4) CRB proposed under the SHCP.</td>
<td>(1) Financial Restructuring Agency (FRA) and (2) Thai Asset Management Corporation only for bad assets of intervened institutions; (3) private FIDF-funded AMC for Bangkok Bank; (4) private tax-free AMCs.</td>
</tr>
<tr>
<td>Asset Management Unit (AMU)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Agency Type</td>
<td>Indonesia</td>
<td>Japan</td>
<td>Korea</td>
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<td>Thailand</td>
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</tr>
<tr>
<td>Deposit Insurance Agency (DIA)</td>
<td>Not yet: IBRA currently administers the full guarantee.</td>
<td>Yes. Deposit Insurance Corporation (DIC).</td>
<td>Yes. Korean Deposit Insurance Corporation (KDIC, 2/1997).</td>
<td>No.</td>
<td>Yes. FOBAPROA: now IPAB, which is to replace the full guarantee with limited deposit insurance by 2005.</td>
<td>No, but is currently being designed.</td>
</tr>
<tr>
<td>Government-approved private initiatives</td>
<td>Government-set principles for loan workouts (Jakarta Initiative); the central bank issued regulations governing loan restructuring.</td>
<td>Cooperative Credit Purchasing Corporation (CCPC).</td>
<td>FSC established debt resolution framework; including the CRCC, which arbitrates disputes.</td>
<td>Banks and finance companies cooperate to acquire troubled institutions; central bank has issued regulations to govern loan restructuring.</td>
<td>Unidad Coordinadora del Acuerdo Bancario Empresarial (UCABE) to facilitate the restructuring of large, syndicated loans.</td>
<td>Yes. The central bank has issued regulations to govern loan restructuring.</td>
</tr>
</tbody>
</table>

Source: IMF staff analysis.
government ownership, the nature of impaired assets, and the type of arrangements to manage these assets most effectively, taking into account internal governance of banks and the country’s legal and institutional environment to enforce property rights and restructure assets. For instance, loans to the national airline may be best managed centrally, while loans to local farmers may be best left on the books of the bank. Overall, a bank should not have all the problem loans taken off its books—it should be “normalized,” not “supernormalized,” both to ensure a level playing field with banks that do not receive assistance and to avoid excessive costs to the public sector.

The principal operational responsibility of the oversight board is to approve the conditions for government assistance eligibility and the terms under which it is granted. Eligibility conditions for public assistance in a bank recapitalization should reflect financial and operational criteria that also assess viability and good governance. More specifically, the eligibility conditions should ensure that a bank:

- has “fit-and-proper” owners and managers (including new ones) or is placed under conservatorship until they can be located;
- recognizes the full extent of its losses, based on realistic valuation criteria;
- submits an acceptable business plan that covers recapitalization to required capital levels and operational restructuring to assure future profitability; and
- mobilizes private sector owners (existing or new) to put up, at least, an agreed portion of the new capital and assumes responsibility for operation of the institution.\(^{15}\)

The terms accompanying the provision of public assistance to an eligible bank should ensure adequate financial and operational restructuring and provide incentives for private owners to rapidly resume efficient and profitable operations. The terms of access to a public capital facility normally include agreements with banks to: (1) restructure operations and balance sheets, with binding performance targets in a memorandum of understanding (MOU), using proper accounting principles, and, if necessary, through due diligence scrutiny by special auditors;\(^{16}\) (2) accept specified restrictions on operations in case of noncompliance; and (3) make arrangements for the repayment of public assistance and the return of ownership to the private sector.

Although the scope and details of the terms would vary according to country- and bank-specific circumstances, these terms could include the following continuing obligations on banks:

- Suspend dividends or incur other sanctions whenever the bank is below the minimum capital adequacy ratio (CAR) or violates specified performance criteria, including achievement of prudential requirements (e.g., maximum open foreign exchange positions) and operational restructuring (e.g., rationalizing the bank’s branch structure). Accept arrangements that would trigger an intensification of government control; for example, a conversion of preferred

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\(^{15}\)These partners need to have sufficient capital at risk to give them a strong incentive to stay with the institution and to work for its survival.

\(^{16}\)In Thailand banks’ financial conditions were assessed by special audits by the banks’ external auditors; in Indonesia, by contrast, all banks were audited by international accounting firms. In some FSU countries overseas supervisors assisted in the assessment of banks’ financial condition.
shares acquired by the government into common stock, under one or more of
the following conditions: (1) when the CAR falls below a specified level; (2)
when the supervisor judges that the bank has otherwise failed to comply with
the terms imposed upon it, and when the violations were avoidable and mate-
rial; or (3) when a previously specified point in time is reached. For example,
under specified conditions, the interest of existing shareholders would be
substantially diluted, and the government would obtain voting control as well
as the right to replace management.

• Accept official oversight through regular and frequent reporting, off-site and
on-site inspections to monitor compliance with time-specific performance
targets for (1) achieving loan classification and provisioning standards; (2)
making improvements to procedures governing credit assessment, risk
management, loan workout, and collateral control; (3) streamlining opera-
tions; (4) cutting costs; (5) bringing excessive foreign exchange positions,
connected lending, and other infringements into compliance with prudential
standards; and (6) arranging government representation on the board of direc-
tors where it is deemed necessary by the BSA and the supervisor.\[17\]

• Allow the public sector to obtain an increasing percentage of the bank’s net
income over time as remuneration for its investment, and as an incentive for
the bank to buy out the government’s stake as soon as possible. With this
design, public funds become progressively burdensome and so the bank will
seek to repay its obligation to the government and replace public funds with
private capital.

• Participate in efforts to restructure corporate debt, to ensure maximization of
loan payments and loan recoveries, and to minimize the capital infusion that
the government and owners have to provide.

To be equitable and to allow the government to cash out of its investment, if
there are private owners left, they should be given an option to redeem the govern-
ment’s capital either throughout the period, or at a specified point in time. In
general, the terms of recapitalization could also include incentives for new investors
in the form of guarantees, such as stop-loss and income-maintenance agreements.

III. Key Decisions

To achieve the objectives for efficient restructuring set by the BRA, its operational
arms—the BSA and the AMC—must jointly make decisions concerning certain
operational issues related to granting capital assistance to banks. Issues discussed
in this section include: (1) the valuation of individual banks’ portfolios and their
future prognosis; (2) whether support should be uniformly available to all viable
banks, or only to those institutions identified as having systemic importance; (3)

\[17\] While many of these functions would be part of the normal, day-to-day work of the supervisors,
there may well be a case for stronger supervision of recapitalized banks. In Indonesia the central bank
established a special surveillance unit to focus on the largest of these banks. Also, while the government
has representatives on the boards of the recapitalized private banks, the Indonesian government has agreed
to a memorandum of understanding with the private owners not to participate in the day-to-day running
of the business.
the selection of individual banks that qualify for and will receive assistance; (4) whether support should be conditional on a full or partial write-off of existing shareholders' claims; and (5) the target level of capitalization that the facility should help the banks to achieve. Other operational issues such as what instruments to use and the means of paying for them are discussed in the next section.

Asset Valuation and Forecasting

Realistic valuation of a bank's balance sheets and off-balance-sheet exposures is a prerequisite for an effective recapitalization strategy, and for an assessment of capital shortfalls. Such valuation is difficult in a crisis environment pervaded by uncertainty because the usual indicators of value are not available, particularly in a crisis and in transition economies. Market prices do not exist where trading has ceased or been disrupted. In addition, the lack of a reliable basis for estimating cash flows, owing to the high volatility of exchange and interest rates in a crisis, impedes valuation based on appropriately discounted present values. The valuation of classified assets, in particular, can be especially problematic.

Moreover, the valuation process is particularly challenging because what is needed is more than a static assessment of current conditions; a prediction of future viability is also essential for identifying banks for recapitalization. Unless it is carefully managed, however, self-assessment invites adoption of favorable and self-serving forecasting assumptions, while external assessments may not be feasible or affordable.

Thus, given the uncertainty during banking crises, alternative valuation approaches have been used to temper the assessments based on traditional procedures. Banks have a responsibility to continually value their assets and make provisions for losses in order to keep their capital intact, and external auditors and supervisors also have a responsibility to continually challenge the banks' valuations. In a banking crisis, however, the authorities in some countries have tried to ascertain realistic values for assets by requiring banks to undertake a special self-assessment of the value of their asset portfolios and future prospects, based on tightened regulations governing loan classification and provisioning, and clear guidance on the assumptions to be employed and the procedures to be followed. In other countries, the BSA has made or checked the assessment itself using, for example, discounted present values of projected income flows. It has also sought independent valuations of bank portfolios by using international accounting firms or investment banks to complement supervisory assessments and external audits.

However, each of these approaches has drawbacks: self-assessments may be biased because of conflicts of interest, other local assessments may not carry sufficient credibility in the market, government assessments may appear inflexible, and international assessors may have a less complete picture of local conditions.

18Sweden, for example, required banks to provide to the BRA data based on universally applied criteria on a common date. The BRA then fed the information obtained from banks and data from other sources (including macroeconomic data and predictions) into a forecasting model, which outlined each bank's likely development over the next three to five years. See Ingves and Lind (1997).
Moreover, critics claim that the auditors place exceptionally low values on assets, perhaps to permit international partners to sign the audits without fearing that the auditors could later be sued for over-optimism in an uncertain environment.\textsuperscript{19} In addition, the auditors may face a conflict of interest if other clients are in line to become the major purchasers of the banks or their assets.

The authorities making restructuring decisions, therefore, have to adopt a pragmatic and transparent approach that incorporates consistent assumptions about key economic variables and best-practice accounting standards, and one that also combines and reconciles alternative valuations to form a realistic judgment. In addition, prospective private investors will want to make their own diligent valuations before deciding whether to acquire equity stakes in banks. Where authorities believe that banks can and will value their assets fairly and realistically, they should require banks to do so. But these valuations need to be checked either by external assessors or the BSA. Where banks cannot or will not conduct a fair assessment, international accounting firms should be hired to do the valuations. In turn, their credibility will need to be checked by the BSA. In all cases, the authorities must clearly specify that the dates for the assessment, the assumptions, and the procedures adopted be the same for assessing asset values and forecasting bank viability.

**What Institutions Should Be Eligible for Government Assistance?**

One important consideration is whether assistance should be confined to commercial banks or include other types of depository institutions, such as savings banks and credit unions, and other financial institutions such as insurance companies, investment banks, and brokerage houses. The answer depends partly on the importance of these institutions' role in an economy. As a general principle, commercial banks rank first in priority, because they are vulnerable to runs in a financial crisis and can have systemic effects. Savings banks, which are sometimes government owned, and house the small savings of households, are usually also eligible for assistance for social and political reasons. Other types of financial institutions usually have lower priority in claiming public funds.\textsuperscript{20}

In general, capital assistance should be available for a limited period to all (commercial and savings) banks that meet the established financial and operational criteria set by the BRA, and that are both willing and able to meet the terms of assistance (laid out in the previous section) so that they can attain a specified minimum CAR and adequate operational restructuring. Capital assistance may

\textsuperscript{19}This criticism was made of the “Big Five” international accounting firms’ work in Indonesia. Also, the Korean government wanted an assessment quickly, and the international partners of the international accounting firms declared themselves unable to sign the audits within the time frame allowed, which reduced their impact.

\textsuperscript{20}The near-failure of a major hedge fund in the United States, in 1998, raised concerns about systemic effects on the banking system and prompted official efforts to preserve the financial institution, which was in the end saved exclusively through the use of private funds. Similarly, the Bank of England rescued Johnson Matthey because of its activities in the gold market.
also be available to banks that meet certain critical needs—for instance, a bank that is the sole provider of payments services in a particular region.

Eligibility for recapitalization should be determined primarily, but not solely, on the basis of financial and operational criteria that indicate potential viability. However, countries sometimes decide that a classification based solely on financial and operational criteria would not provide a workable resolution for banks that are weak but deemed essential, or of systemic importance to the economy. For example, it may not be feasible to close a very large bank in an orderly fashion, or one that dominates a region of the country, underpins the payments system, or has a special niche in the credit markets. Such exceptions to resolution criteria on the grounds of “essentiality” should be made only under very limited and tightly managed conditions to thwart political pressures.21

The resolution of both private and state-owned banks should be broadly governed by the same objectives and principles, although the resolution of state banks may often face special circumstances due to their size and credit exposures. As with the private banks, recapitalization of state banks should be linked to realistic valuation based on internationally accepted accounting standards, fit-and-proper management, and financial and operational restructuring to ensure viability and adherence to prudential standards.

Which Banks Should Receive Government Assistance?

To determine which banks to give assistance to, the BSA must first do a classification. Figure 2 shows an example of four categories of banks. All of these begin from a position of measured capital above the CAR. In the worst category, Bank D is projected to deteriorate rapidly into deep and irretrievable insolvency. There does not appear to be any reason for this bank to receive direct government assistance because where there is a blanket guarantee and the bank is small, it is preferable to pay off the depositors and arrange to dispose of the assets rather than to recapitalize the bank. If the bank is large, however, and systemically important, the least-cost solution may still be recapitalization. Banks B and C in Figure 2 are under consideration for direct assistance; they fall below the minimum required capital level but ultimately are expected to recover if assisted. Bank B might recover very slowly without assistance, but Bank C would not. Both of these banks are willing and able to meet the terms and conditions of assistance discussed in Section II above. Bank A, in the fourth and best category, remains solvent without assistance.22

A difficult decision is whether to aid Bank B, which the valuation exercise predicts has a higher probability of recovering without aid as compared with Bank C, which is expected to become insolvent without financial assistance but which could recover with aid. If the BRA believes that the country is “over-banked,” and neither bank is systemically important, it could close both. If it judges that the

21For instance, in Indonesia, the authorities declared that all the state banks were “too big to fail” and all would be recapitalized.
country is over-banked but that it needs to assist one bank in order to maintain sufficient competition among banks, it should aid the stronger Bank B and close Bank C. If both banks are needed, the BRA may support both. If budgetary resources are constrained, the BRA will need to try to spread out the necessary financing over a longer period or elicit greater private sector participation, including foreign investment.

**Treatment of Existing Shareholders’ Claims**

As a general rule, the financial claims of banks’ existing shareholders and subordinated debtors should be written down in accordance with their seniority in the legal system in order to cover the losses an institution has incurred. Apart from reducing the contribution of public funds needed to eliminate the possible negative net worth of the institution, this write-down also avoids setting precedents that can result in moral hazard. Where limited liability is not in force, shareholders may also be required to subscribe additional capital.

In crisis situations, such as in Asia in 1997–98, banks can fail as a result of past directed lending and exogenous factors (e.g., macroeconomic instability) despite good management, “fit-and-proper” owners, and initially strong capitalization. In these cases, the government may face a moral or legal responsibility to
RECAPITALIZING BANKS WITH PUBLIC FUNDS

repay the losses, and may take steps to keep existing owners and managers in place, and to persuade them to invest new capital.23

In some countries, the insolvency that is revealed from writing down owners' capital triggers supervisory action in which the bank loses its license, and is either merged or closed and liquidated. In other countries, the legal system allows owners to remain in control of the bank even after their shares have been written down to nominal values.24 At times it may be necessary to allow existing shareholders to retain partial ownership rights in order to obtain their cooperation, and to avoid time-consuming and costly legal wrangles. Where the authorities are considering supporting an insolvent bank whose shareholders are protected, such support should be predicated on the shareholders themselves also providing new capital.

Experience has shown that owners, especially new investors, may be induced to provide fresh capital if the uncertainty they face is reduced by instruments that guarantee outcomes. For example, the government may agree to share losses with the owner or new investor (in a “loss-sharing” arrangement); place a cap (a “stop-loss” provision) on the amount a bank may lose; agree to maintain bank income at a specified level (in an “income- or yield-maintenance” provision); or allow the bank to return some or all of the bad assets it purchases to the government (through a “put-back” provision). More specifically, such guarantees and options can be given, with appropriate safeguards, to limit an acquirer’s losses during a review period (in which additional questions on “skeletons” may come to light). Guarantees may cover asset values or yields that an institution will earn on certain assets specified in the recapitalization contract.25 While inducements to new investment have been used successfully in many countries, a government needs to be confident that it can convey positive incentives to new owners to maximize both the value of recoveries and efforts to maintain and improve the value of the acquired assets. Guarantees can create an illusion of ownership in that, technically, a bank can have private ownership while all the risk is borne by the government.

Finally, using the legal system to obtain redress for criminal acts or regulatory violations committed by owners and others may reduce the government’s fiscal obligations, while preserving incentives for good governance.

23For example, even where shares are written down to zero, human resource constraints might suggest that “fit-and-proper” shareholders be retained on the board of directors and be given stock options tied to future performance. Alternatively, an insolvent bank might be closed and a new charter issued to the former owners, conditional upon their injection of new capital. On the other hand, the mere fact that there was directed lending, or government interference, does not mean that banks’ managements can necessarily walk away completely from the problems in their banks. Their “fitness and propriety” as well as responsibility for problems in the past may well be a matter of judgment for the authorities in general, and for the bank supervisors in particular.

24The former applies in most industrial countries; the latter, for example, in most Asian crisis countries.

25These techniques have all been used by the Bank Insurance Fund (BIF) and the RTC in the United States. Malaysia has provided asset guarantees to acquirers of merged finance companies, Korea has given put options to acquiring banks in purchases and assumptions (P&As), and Thailand has provided stop-loss guarantees and yield-maintenance agreements to new investors taking over intervened banks.
The Size of the Recapitalization

When there is a blanket guarantee for depositors and other creditors, recapitalizing a bank to a zero CAR (bare solvency) is roughly equivalent to honoring the guarantee without making a payout to depositors and creditors. In systemic crises, recapitalizing to bare solvency, given the limited supply of private capital (domestic and foreign), may not be sufficient to establish credibility in the soundness of a recapitalized banking system, and it may well be desirable for the government to recapitalize selected banks to some positive minimum level. Where the fiscal situation permits, the government may recapitalize banks to the Basel Committee on Banking Supervision standards or even higher, while taking a commensurate ownership interest.26 Such decision will depend on competing fiscal demands as well as on how much authorities expect “overcapitalization” to restore confidence in the system among bank customers and potential investors.

Burden-Sharing Recapitalization

The amount of public funds needed to recapitalize the banking system depends, in part, on the willingness of private investors—existing and new—to put up a share of the capital needed. Their willingness in turn will depend on the distribution of ownership after recapitalization, and the guarantees and contractual terms designed to reduce uncertainty and apportion losses and profits.

Where the law does not call for limited liability for bank owners, shareholders may be required to recapitalize their bank. Even where limited liability is in place, it may be possible to design the recapitalization so that the shareholders are encouraged to reduce the call on government funds in certain ways.27 They might be induced to: (1) bear losses beyond their original capital and share the financial responsibility with the government for “filling the gap” and bringing the bank up to bare solvency; and (2) contribute additional capital to help meet the minimum CAR. This approach of persuading existing shareholders to “fill in the gap” is equivalent to denying limited liability—a provision frequently regarded as a protection needed to encourage shareholders to invest in an enterprise or bank.28

In order to encourage new shareholders to participate in a recapitalization, it may be necessary to give them preferences over existing shareholders. Such preferences could be, for example, that old shareholders shoulder the burden of any additional depreciation of existing assets before new shareholders are called upon to incur losses.29 Any additional losses on specified old assets would be under-

26 Korean banks have been recapitalized to 10 percent, to allow them to survive some further deterioration in asset quality.
27 Unlimited liability is not uncommon. Before granting a license, supervisors frequently require shareholders to undertake, for example, in a comfort letter to keep their bank adequately capitalized.
28 Nevertheless, this approach is being tried in Indonesia, where the capital support facility for private banks requires contributions from existing shareholders to “fill in the gap” in return for the opportunity to buy back the government shares later and to reacquire the bank under specific conditions.
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written by a government guarantee so that new shareholders are only held responsible for losses incurred on the nonguaranteed assets. Alternatively, new shareholders could receive, at least for a limited time, a disproportionately larger share of future dividends. In some countries, the laws (for example, those that govern rights issues) would need to be changed to permit such differentiation among shareholders. In other countries, it may be sufficient to persuade old shareholders to agree to the arrangement on pain of being dispossessed entirely.

IV. Modalities of Government Support: Capital Injections

After making decisions about which banks to recapitalize, the BSA must then choose the best ways to provide the funding. In principle, there are a number of instruments that the government can use to strengthen a bank's capital adequacy: injecting capital with public funds; rehabilitating assets; reducing liabilities; and improving net income. \(^{30}\) This section focuses on issues related to capital injections, particularly what instruments to use and how to pay for them. Other instruments are discussed in the following two sections.

Tier 1 and Tier 2 Instruments

An increase in paid-in equity or Tier 1 capital is the preferred form of recapitalization because it improves the capital ratios, can enhance profitability, and is essential under the Basel Capital Accord. It does not involve immediate servicing costs, since dividend payments could and should be postponed until the bank's capital and income are fully and durably restored. The government’s provision of Tier 1 capital can also facilitate the bank’s efforts to raise Tier 2 capital from private sources. The components of Tier 1 and Tier 2 that are recognized by the Basel Committee are listed in Box 1. The actions of six countries in providing Tier 1 and Tier 2 capital to recapitalize their banks are shown in Table 2, which reports the capital instruments used and the means of payment adopted. Table 3 reports other financial actions, such as granting loans and issuing guarantees.

When recapitalization with public funds leads, in effect, to nationalization, \(^{31}\) this should be regarded as a transitional arrangement designed to strengthen management and operations, and should lead to reprivatization in due course—preferably according to a specific time frame. Consequently, the BSA needs to choose its capital instruments with consideration of its ability to redeem them later. Two financing decisions need to be made—which instruments to acquire, and how to pay for them. One option is that the government could purchase common stock, which may be more marketable than other instruments when the government decides it wants to recover its investment. The BSA, however, may not want to take control under circumstances where it believes that privately controlled operations are more efficient, or where it believes abstaining from

\(^{30}\)See Dziobek (1998).

\(^{31}\)Nationalization is the usual outcome in cases where insolvency is deep and the bank is regarded as systemically important.
Box 1. Capital Instruments in Use in Banks

<table>
<thead>
<tr>
<th>Tier 1 Instruments (Core Capital)</th>
<th>Characteristics</th>
<th>Examples of Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issued and fully paid ordinary shares</td>
<td>Must be: (i) issued and fully paid; (ii) noncumulative; (iii) permanent; (iv) able to absorb losses within the bank on a going-concern basis; (v) junior to depositors, general creditors, and subordinated debt; (vi) neither secured nor guaranteed by the issuer; (vii) publicly disclosed; and (viii) immediately and fully available without limit to the issuing bank.</td>
<td>Many: including Mexico, Malaysia, Finland, Sweden</td>
</tr>
<tr>
<td>Disclosed reserves from retained after-tax earnings or other surplus</td>
<td>Not secured or guaranteed, callable by issuer only after a minimum of 5 years and with supervisory approval.</td>
<td>Many: Mexico</td>
</tr>
<tr>
<td>Perpetual, noncumulative preference shares</td>
<td></td>
<td>Thailand, Japan</td>
</tr>
<tr>
<td>Convertible, noncumulative preference shares</td>
<td></td>
<td>Thailand, Indonesia, Japan, Finland, Sweden, Malaysia</td>
</tr>
<tr>
<td>Minority interests in equity of less than fully owned subsidiaries whose accounts are consolidated and that meet certain conditions and do not exceed 15% of Tier 1 capital</td>
<td></td>
<td>Portugal, Spain, Thailand, U.S.A.</td>
</tr>
<tr>
<td>Innovative, synthetic, capital instruments Limited to &lt;15% of consolidated Tier 1 capital</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tier 2 Instruments (Supplementary Capital)</th>
<th>Characteristics</th>
<th>Examples of Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undisclosed reserves</td>
<td>Unencumbered; immediately available</td>
<td>Japan, Mexico</td>
</tr>
<tr>
<td>Asset revaluation reserves</td>
<td>Prudently valued with a discount &lt;=1.25% of risk-weighted assets</td>
<td>U.K., Japan, Mexico</td>
</tr>
<tr>
<td>General provisions/loan-loss reserves</td>
<td>Must: (i) be unsecured, subordinated, fully paid-up; (ii) not be redeemable without the prior consent of the supervisor; (iii) be available to participate in losses without the bank having to cease trading; and (iv) allow servicing obligations to be deferred where the bank’s profitability would not support payment.</td>
<td>Many: Mexico, Malaysia</td>
</tr>
<tr>
<td>Hybrid debt/equity instruments including,</td>
<td>Not normally available to share losses unless bank closes; thus, not to exceed 50% of Tier 1 capital.</td>
<td>Several</td>
</tr>
<tr>
<td>Cumulative long-term preference shares</td>
<td></td>
<td>Canada, France</td>
</tr>
<tr>
<td>Convertible cumulative preference shares</td>
<td>Minimum original term to maturity of over five years with a discount of 20% in each of last five years to maturity.</td>
<td>Germany, U.K., Thailand, U.K., U.S.A.</td>
</tr>
<tr>
<td>Titres participants and titres subordonnés a durée indéterminée</td>
<td></td>
<td>U.S.A.; Finland</td>
</tr>
<tr>
<td>Genusscheine</td>
<td></td>
<td>Mexico, Thailand, U.S.A., Malaysia</td>
</tr>
<tr>
<td>Perpetual subordinated debt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preference shares</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mandatory convertible debt instruments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subordinated term debt instruments including:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conventional unsecured subordinated debt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convertible subordinated debt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limited-life redeemable preference shares</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deductions from capital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goodwill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investments in unconsolidated financial subsidiaries</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


1Thailand, for example, issues Stapled Limited Interest Preferred Securities (SLIPS) that are attached to high-rate subordinated debt that pays interest even when there are no profits. U.S. bank holding companies can issue "trust preferred" or "capital securities" and pass the proceeds on to their banks as Tier 1 capital. European countries have issued "step-up callable preferred securities." 

2Specific loan-loss reserves are not countable as capital under the Basel Capital Accord, although some countries do so. Japan, for example, counts reserves against substandard loans, but not doubtful or loss loans, as Tier 2 capital. 

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Table 2. Actions by the Public Sector to Provide Tier 1 and Tier 2 Capital

<table>
<thead>
<tr>
<th>Instrument/Payment</th>
<th>Indonesia</th>
<th>Japan</th>
<th>Korea</th>
<th>Malaysia</th>
<th>Mexico</th>
<th>Thailand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide capital</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes, for at least 10 banks.²</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Tier 1:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common stock</td>
<td>Yes</td>
<td>Yes, but rare.</td>
<td>Yes: government and KDIC for development, intervened, and merged commercial banks.</td>
<td>Yes.</td>
<td>BOM/FOBAPROA in intervened and small financial institutions to end insolvency and permit private recap.</td>
<td>Yes.</td>
</tr>
<tr>
<td>Pay in cash</td>
<td>No</td>
<td>Yes</td>
<td>Yes: through the KDIC; otherwise to development banks.</td>
<td>Yes: using proceeds from issuing Danamodal bonds.</td>
<td>No</td>
<td>Financial Institution Development Fund (FIDF) converted some LOLR support into equity in intervened banks.</td>
</tr>
<tr>
<td>Instrument/Payment</td>
<td>Indonesia</td>
<td>Japan</td>
<td>Korea</td>
<td>Malaysia</td>
<td>Mexico</td>
<td>Thailand</td>
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</tr>
<tr>
<td>Pay with bonds</td>
<td>Yes.</td>
<td>Not yet. But DIC will probably issue short-term bonds.</td>
<td>Yes: stocks in public enterprises owned by the government to nationalized banks; gov't-guaranteed KDIC bonds.</td>
<td>No.</td>
<td>10-year, FOBAPROA zero-coupon, non-tradable bonds. IPAC will issue negotiable, gov't-guaranteed, bonds to replace FOBAPROAs.</td>
<td>No.</td>
</tr>
<tr>
<td>Preferred stock</td>
<td>No.</td>
<td>Yes; now mostly convertible; if bank raises private capital and makes new loans.</td>
<td>Yes: for acquirers in P&amp;As for five commercial banks.</td>
<td>Yes: bought by Danamodal.</td>
<td>In intervened and merging banks.</td>
<td>Yes: up to 2.5% Tier 1, then match private contributions 1:1.</td>
</tr>
<tr>
<td>Instrument/Payment</td>
<td>Indonesia</td>
<td>Japan</td>
<td>Korea</td>
<td>Malaysia</td>
<td>Mexico</td>
<td>Thailand</td>
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<td>------------------------------------------</td>
</tr>
<tr>
<td>Pay with bonds</td>
<td>Yes: (1) indexed, (2) regular, both negotiable.</td>
<td>No: DIC issues govt.-guaranteed bonds and borrows from BOJ to raise cash.</td>
<td>KDIC sells bonds to provide cash.</td>
<td>No.</td>
<td>10-year, FOBAPROA zero-coupon, non-tradable bonds. IPAC will issue negotiable bonds to replace FOBAPROAs.</td>
<td>10-year, tradable, govt., bonds with market-related interest rate.</td>
</tr>
<tr>
<td>Tier 2: Subordinated debt</td>
<td>No (LOLR support converted to sub. debt before the crisis).</td>
<td>Yes, more common than equity.</td>
<td>Yes: early P&amp;As for five closed banks.</td>
<td>Yes.</td>
<td>Banks issued to govt. callable, 5-year sub. debt mandatorily convertible into equity after 5 years or when CAR is &lt; 2.</td>
<td>Yes: to 2% of risk assets if bank restructures corporate debt and makes new loans.</td>
</tr>
</tbody>
</table>
### Table 2. (concluded)

<table>
<thead>
<tr>
<th>Instrument/Payment</th>
<th>Indonesia</th>
<th>Japan</th>
<th>Korea</th>
<th>Malaysia</th>
<th>Mexico</th>
<th>Thailand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pay in cash</td>
<td>No.</td>
<td>Yes.</td>
<td>No.</td>
<td>Yes.</td>
<td>Yes, but sterilized as increased reserves at BOM.</td>
<td>No.</td>
</tr>
<tr>
<td>Pay with bonds</td>
<td>No.</td>
<td>Not directly, but the government issues bonds to fund the cash injection.</td>
<td>Government-owned exchange-quoted stocks in public enterprises.</td>
<td>No.</td>
<td>IPAC will issue negotiable bonds to replace FOABAPROAs bonds.</td>
<td>Yes: government buys bank debentures with government 10-year bonds at lower market-related rate.</td>
</tr>
<tr>
<td>Memo: allow more foreign ownership</td>
<td>Yes: law amended to permit up to 99% foreign ownership of banks.</td>
<td>There are no restrictions on the foreign ownership of banks.</td>
<td>Yes: have eased legal restriction, and foreigners, including the IFC, have bought stakes in 4 banks.</td>
<td>Yes; for financial institutions and limits on purchase of real estate by foreigners relaxed.</td>
<td>Eased before, ended remaining restrictions on foreign participation in existing banks in December 1998.</td>
<td>Existing restrictions have been waived for 10 years.</td>
</tr>
</tbody>
</table>

Source: IMF staff analysis.

1 The public sector includes the government, the central bank as lender of last resort (LOLR), the deposit insurance corporation (DIC), the AMC, the restructuring agency, and any vehicle for recapitalizing banks.

2 Aided banks must have sold their bad assets to Danaharta and have CARs below 10 percent.
Table 3. Public Sector Loans and Guarantees to Support Banks

<table>
<thead>
<tr>
<th>Instrument/ Payment</th>
<th>Indonesia</th>
<th>Japan</th>
<th>Korea</th>
<th>Malaysia</th>
<th>Mexico</th>
<th>Thailand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide loans</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Only to intervened banks and to honor the guarantee.</td>
</tr>
<tr>
<td>Long-term</td>
<td>No: but de facto short-term loans are rolled over.</td>
<td>No.</td>
<td>BOK to the Bridge Merchant Bank.</td>
<td>No.</td>
<td>To intervened and small banks.</td>
<td></td>
</tr>
<tr>
<td>Instrument/Payment</td>
<td>Indonesia</td>
<td>Japan</td>
<td>Korea</td>
<td>Malaysia</td>
<td>Mexico</td>
<td>Thailand</td>
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<td>----------</td>
</tr>
<tr>
<td>Bank liabilities</td>
<td>Yes: from 1/98 for at least 2 years, with 6 months’ notice of termination; includes off-balance-sheet items; not shareholders and sub. debt holders or connected parties.</td>
<td>Yes: from 1997 through March 2002, may be extended to cover subordinated debt.</td>
<td>11/97 until 12/00 on most liabilities (including some inter-bank claims) of all financial institutions.</td>
<td>Yes: from 1/98 indefinitely.</td>
<td>Yes: until 2005 IPAB replaces FOBAPROA’s guarantee on all, including foreign exchange, debts but not sub. debt.</td>
<td>Yes: from 10/97 indefinitely.</td>
</tr>
</tbody>
</table>
Table 3. (concluded)

<table>
<thead>
<tr>
<th>Instrument/ Payment</th>
<th>Indonesia</th>
<th>Japan</th>
<th>Korea</th>
<th>Malaysia</th>
<th>Mexico</th>
<th>Thailand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank assets</td>
<td>Indonesia</td>
<td>Japan</td>
<td>Korea</td>
<td>Malaysia</td>
<td>Mexico</td>
<td>Thailand</td>
</tr>
<tr>
<td>Guarantee associations</td>
<td>Indonesia</td>
<td>Japan</td>
<td>Korea</td>
<td>Malaysia</td>
<td>Mexico</td>
<td>Thailand</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Indonesia</td>
<td>Japan</td>
<td>Korea</td>
<td>Malaysia</td>
<td>Mexico</td>
<td>Thailand</td>
</tr>
<tr>
<td>No; apart from long-standing export guarantee scheme.</td>
<td>No; direct government lending.</td>
<td>Yes; (1) informal guarantee of foreign exchange debts; (2) Korean Guarantee Corp. (KGC); (3) Korean Technology Guarantee Fund (KOTEC); (4) up to 100% on loans to SMEs; (5) put options for acquiring banks in P&amp;As.</td>
<td>Yes: for the bad assets of Banks Sime and Bumiputra.</td>
<td>Yes: via FOBAPROA, which lent to companies that were indebted to banks.</td>
<td>Profit &amp; loss-sharing, stop-loss, and yield maintenance agreements for new investors in intervened banks; e.g. loss-sharing for intervened Krung Thai Bank.</td>
<td></td>
</tr>
</tbody>
</table>

Borrowers | No; apart from long-standing export guarantee scheme. | No; direct government lending. | Yes: credit guarantees for SMEs. | The government guarantees Danaharta bonds. | Yes: many, such as UDIs and preferential exchange rates. | No. |

Source: IMF staff analysis.

1The public sector includes the government, the central bank as lender of last resort (LOLR), the deposit insurance corporation (DIC), the asset management company (AMC), the restructuring agency, and any vehicle for recapitalizing banks.

2The deviation of the guarantee has been extended.

3See Table 4 for the details.
asserting such control would significantly increase incentives for the private sector to bring in more capital. In a situation like this, the BSA would prefer to purchase convertible preferred shares, which count as Tier 1 capital under the Basel Committee’s rules, and can be constructed to convey voting rights under a variety of restricted arrangements. Nonetheless, the government could retain veto rights on identified strategic issues relating to bank portfolios and operations.

Where the government wishes to obtain control of the bank, in case the bank’s condition deteriorates, the preferred stock would be converted into common equity under the specified conditions. Convertible, preferred shares count as Tier 1 capital, provided they are undated and noncumulative. They carry a prior entitlement to any income earned, but they do not give the holder voting power in normal circumstances, and so they help to reduce any potential conflict of interest for the government. The trigger for conversion could, for example, be a decline in the CAR below some threshold value (4 or 6 percent, for example) or other material failure to meet the terms for continued assistance listed in Section II. The rate for converting preferred into common shares should dilute the common stock and give the government control.

The tension between satisfying the Basel Committee’s requirement that capital instruments cannot qualify as Tier 1 capital if they are redeemable and the government’s wish to recover its investment over time must be handled by ensuring that there will be a secondary market where the stock can be sold. The stock can be designed to give the owners the option to redeem them, with the consent of the government, if the bank is in good condition, and if the remaining Tier 1 capital would keep the bank above the minimum requirement after redemption. The government, however, would not have the power to redeem the shares from the bank because that would disqualify the shares from inclusion in Tier 1 capital.

**Forms of Payment**

In terms of payment, Tier 1 capital provided by private investors should be paid for by injecting cash; submissions in-kind are not acceptable. The government may contribute cash and/or bonds (either negotiable or nonnegotiable). Cash and bonds immediately increase net worth and improve the capital ratios, liquidity, and potential profitability. Bonds are often a convenient source of payment for the government. The downside to this convenient arrangement is that banks may prefer to retain the bonds as a risk-free source of income, rather than to make loans and ease the crisis-induced credit crunch. If bonds are to be used, they should...

---

32 The government could also retain specific rather than general voting powers, to allow it to approve the details of a merger, for example.

33 These are popular among “white knight” acquirers because they allow the acquirers to rescue a corporation, while ensuring that they can exit first if trouble occurs. Convertible preferred shares are being used by the Japanese government, as well as in Thailand and Indonesia.

34 CARs are improved because equity increases and the value of risk-weighted assets falls, as both cash and government bonds have zero risk weight under the Basel standards.

35 Authorities sometimes place indexed bonds with banks to lower the initial costs of debt service and to mask the full costs of recapitalization. However, costs to the government could rise and banks could benefit if inflation escalates.
RECAPITALIZING BANKS WITH PUBLIC FUNDS

pay market, not submarket, interest rates. A decision about whether market rates will be denominated in nominal or real terms (with the principal indexed for inflation) must be made. Bonds paying fixed nominal rates will give banks greater liquidity during the early years of the life of the bond over bonds that pay real rates, but paying nominal rates increases immediate government outlays.  

It is for these reasons that direct placement of government paper with the banks is the most common practice when purchasing bank capital. As stated previously, these bonds should pay market rates. As market rates are likely to be high initially, due to uncertainty, the bonds should carry variable rates, so that the government’s debt service costs will decline as rates fall.

It might be expected that the government would opt to inject negotiable bonds, which encourage market development and also facilitate liquidity management by banks. However, there is a risk in supplying negotiable bonds that the recipient will sell the bonds and reinvest unwisely in unsafe assets in a gamble for recovery. Fit-and-proper owners and managers, and very close supervision, are necessary to limit this risk. It may, therefore, be appropriate to contain negotiability for an initial period when the management, governance, and operational restructuring plans are being strengthened as part of the terms of government assistance.

Giving Guarantees

During the recent crises, all governments in the major crisis countries have issued blanket guarantees to a bank’s depositors and frequently its creditors. In addition to these guarantees on the liabilities of a bank, governments have in some cases guaranteed bank assets and/or income streams (see Table 3).

Guaranteeing liabilities forestalls runs and prevents potential losses from having to sell assets in a fire sale and from high-cost borrowing to repay depositors. Such a guarantee should enable a return to relative stability in the banking system, enabling the authorities to deal with the banking situation in a properly sequenced and calm manner. Insofar as the holders of the deposits are other financial institutions, a guarantee should serve to revive the interbank market, which typically dries up during a banking crisis, and thus enable the continuation of intermediation across the banking system.

Guaranteeing income (for instance through “stop-loss guarantees”) allows banks to increase capital through retained earnings. This may be particularly helpful for prospective bank purchasers, especially in cases where there is substantial uncertainty about the value of a bank’s assets and prospects for recovery. Guarantees are appealing politically because they appear to be a substitute for additional immediate expenditures on Tier 1 or Tier 2 capital, and they offer some

36 Indonesia has used indexed bonds; see Table 2.
37 This has occurred in Korea and Thailand, and is being considered in Indonesia.
38 The government of Thailand charges banks 0.4 percent of liabilities annually for the guarantee it is providing. Indonesia charges banks 0.25 percent of liabilities.
39 Among the Asian crisis countries this technique has been used particularly in Thailand, where banks have not all been subject to audit by international accountants and where the authorities have been particularly aggressive in seeking new private investors at an early stage.
protection against giving windfall gains to bank investors in the event that the bank's situation turns out better than expected. Although widely used, they are not a "free lunch" for the government, which carries contingent liabilities that it may have to honor. In the absence of proper fiscal transparency, guaranteeing income may serve to disguise the costs of handling a banking crisis. Guaranteeing assets may involve providing assistance to the borrowers of a bank, frequently the corporate sector. With increasing recognition that bank and corporate restructuring are closely intertwined, support for the corporate sector may be part of the authorities' overall strategy for handling a pervasive economic crisis.

Guaranteeing assets and income—to a level beyond that which is otherwise projected in the market—increases asset values, which improves the balance sheet and measured capital. Not only will such guarantees raise the market value of the assets covered, but—if they guarantee a return greater than the written-down value—they also enable the bank to recover any provisions that it has previously made against the assets. Both effects will boost capital. However, with proper fiscal accounting, the contingent claims on the government will need to be shown all at once, as would the immediate expenditures on bank capitalization. Suspicion therefore exists that countries that pursue this route may not disclose full fiscal transparency. In any case, there is rarely, if ever, a full and realistic estimate of the potential costs of the guarantees when they are given and, thus, may be a major reason for continual escalation of bank restructuring costs long after the authorities seem to have got a handle on the situation.

V. Supporting Banks by Transferring Their Assets

In addition to injecting various forms of capital with public funds, the government can purchase and rehabilitate bank assets and facilitate business- and household-debt workouts to aid banks. It can also reduce bank liabilities, raise income, and grant forbearance. The actions of six countries in this area are shown in Table 4. This section discusses asset rehabilitation and debt workouts. The other types of actions are reviewed in Section VI.

Asset rehabilitation is an important concomitant reform that either is operationally linked to capital assistance programs, or otherwise strongly influences the effectiveness of such programs in supporting economic recovery and thereby reduces the net cost to the government. Asset rehabilitation is both a substitute for, and a complement to, capital injections. In principle, bad assets can either be: (1) retained and managed by banks themselves at appropriately written-down values, while the banks receive financial assistance from the government for recapitalization; or (2) relocated or sold to one or more decentralized "bad banks," loan recovery companies, or privately owned AMCs that specialize in the management of impaired assets; or

---

40 Corporate restructuring is beyond the scope of this paper. It is becoming increasingly recognized that bank restructuring without corporate restructuring may be self-defeating, because if banks' problems stem from problems with their customers, then addressing customers' problems is critical to remedying the underlying situation facing the banks.

41 There are obvious moral hazard effects if the original owners stand to benefit from these guarantees. There is, therefore, a strong case for making the granting of guarantees conditional upon fulfilling conditions similar to those discussed above for government assistance with bank recapitalization.

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<table>
<thead>
<tr>
<th>Action</th>
<th>Indonesia</th>
<th>Japan</th>
<th>Korea</th>
<th>Malaysia</th>
<th>Mexico</th>
<th>Thailand</th>
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</thead>
<tbody>
<tr>
<td>Aid assets</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>No.</td>
</tr>
<tr>
<td>Buy bad assets</td>
<td>Loss loans only in recapitalized banks; assets of closed banks.</td>
<td>Resolution and collection corporation buys bad assets from failed and operating banks.</td>
<td>Yes: initially from all banks; now less often and only to aid restructuring deals.</td>
<td>Yes: since 8/98 buying large bad loans from 18 banks by year-end 1998.</td>
<td>Yes; (1) FOBAarroa buys 2 pesos of bad loans for every peso of additional private capital; (2) banks' UDI loans and foreclosed real estate transferred to trust funds.</td>
<td>In principle, the AMC buys only from intervened institutions.</td>
</tr>
<tr>
<td>Action</td>
<td>Indonesia</td>
<td>Japan</td>
<td>Korea</td>
<td>Malaysia</td>
<td>Mexico</td>
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</tr>
<tr>
<td>Pays with</td>
<td>Buys at zero value.</td>
<td>Cash (obtained from bond issues).</td>
<td>70% in government-guaranteed KAMCO bonds, 30% cash.</td>
<td>Cash or zero-coupon, govt-guaranteed, Danaharta bonds.</td>
<td>5-year or 10-year, variable-rate, non-negotiable, zero-coupon FOBAPROA bonds.</td>
<td>5-year bonds without a government guarantee.</td>
</tr>
<tr>
<td>Other actions</td>
<td>(1) Loan-loss provisions (LLP) made tax-deductible; (2) publication of list of large delinquent borrowers.</td>
<td>As no automatic tax deduction for LLP; banks created the Coop. Credit Purchasing Co.; deferred taxes.</td>
<td>Removed limit on tax deductibility for LLP. Put options in P&amp;As for acquiring banks.</td>
<td>LLP tax deductible; national pension fund bought &quot;under-valued&quot; shares; eased reserve and liquidity requirements and loan limits; credit floor.</td>
<td>(1) 25:75 loss-sharing (bank: govt) on bad loans; (2) facilitate the creation of credit bureaus.</td>
<td>Tax deductibility for LLP, stop-loss, and yield maintenance guarantees for new investors taking over intervened banks.</td>
</tr>
<tr>
<td>Action</td>
<td>Indonesia</td>
<td>Japan</td>
<td>Korea</td>
<td>Malaysia</td>
<td>Mexico</td>
<td>Thailand</td>
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</tr>
<tr>
<td>Restructure debt</td>
<td>Yes: Indonesian Debt Restructuring Agency (INDRA); and the Jakarta/ London Initiative. IBRA and the state banks will embark on restructuring discussions, beginning with the 20 largest borrowers.</td>
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<tr>
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<td>Can now tax-deduct debt forgiveness in a comprehensive restructuring plan. Limits on bank ownership of equity have been raised to facilitate debt-equity swaps. There are also private initiatives; and restrictions on the foreign purchase of automobile companies, real estate, and brokerage houses have eased.</td>
<td></td>
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<tr>
<td></td>
<td>Yes: the FSC's Corporate Restructuring Agreement (CRA) uses a modified London Approach to guide restructuring. Private Corporate Restructuring Coord. Committee (CRCC), arbitrates disputes for all but the 5 largest chaebols; for these, it is proposed to concentrate ownership where there is excess capacity under a Structural Improvement Plan. The CRA has been signed by 200 financial companies.</td>
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<td>Yes: Corporate Debt Restructuring Committee (CDRC) had received 42 applications for aid by end-1998; more in 1999; works with creditors and debtors to effect workouts. Banks threaten to sell delinquent loans to Danaharta which has extensive powers over the borrowers of any loans it buys.</td>
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<td>(1) Unidad de Inversion (UDI) converted floating rate peso and dollar loans into long-term fixed-rate loans denominated in UDIs for household mortgages, loans of corporations, states and municipalities and development banks; (2) Programa de Apoyo Inmediato a Deudores de la Banca (ADE) provided an interest subsidy to small borrowers that remained or became current; (3) assistance for highway concessionaires that restructured their loans in UDIs;</td>
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<td>Corporate Debt Restructuring Advisory Committee (CDRAC) uses the Bangkok/ London Approach for workouts; classification standards for restructured loans were relaxed and tax impediments removed temporarily; tax exemptions are granted; a draft law establishes centralized credit bureaus; legal amendments will facilitate greater foreign ownership of property;</td>
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<td>Action</td>
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<td>Restructure debt</td>
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<td>(4) discount on</td>
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<td>rate reductions,</td>
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<td>debt forgiveness,</td>
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<td>debt forgiveness,</td>
<td>mortgage debtors</td>
<td>BOT is trying to</td>
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<td>and exchanging</td>
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<td>that restructured</td>
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<td>debt for equity or</td>
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<td>convertible bonds</td>
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<td>(5) FINAPE's discount on</td>
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<td>Cooperatives</td>
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<td>borrowers in the agricultural</td>
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<td>and fishery industries that</td>
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<td>gave assistance to</td>
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<td>loans are current.</td>
<td>offers rebates on</td>
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</table>

Source: IMF staff analysis.

1 The public sector includes the government, the central bank as lender of last resort (LOLR), the deposit insurance corporation (DIC), the asset management company (AMC), the restructuring agency, and any vehicle for recapitalizing banks.
RECAPITALIZING BANKS WITH PUBLIC FUNDS

(3) sold and transferred to a centralized AMC, which is typically state-owned. In the 1997–98 Asian crisis all countries accorded a significant role to this last option.

The government can purchase some or all of banks’ impaired assets outright, and such action can be helpful under certain conditions. The value of loans (good or bad) on the bank’s books will decline and the amounts of cash and government (or government-guaranteed) bonds will rise. This substitution lowers the value of risk-weighted assets and raises the risk-weighted CAR. It thus facilitates compliance with prudential requirements; moreover, by reducing the riskiness of a bank’s overall portfolio it may change the incentive structure for banks’ managements. Asset purchases should, however, be supported by appropriate institutional arrangements for the resale of assets, debt workouts, and loan recoveries, so as to maximize the market value of purchased assets, and reduce the ultimate cost to the government. For this reason the crisis countries have typically created a special agency—an AMC—to acquire and handle bad assets (see Table 1).

Certain decisions must be made before the creation of an AMC
1. Do the advantages of asset purchases by a government agency outweigh the disadvantages and warrant establishment of a centralized AMC?
2. Should the agency buy only from banks that are to be liquidated, or also from banks that are being assisted, or from any bank that wishes to sell its assets, regardless of that bank’s condition, and whether the government has taken over the bank?
3. Will the AMC buy both good and bad assets?
4. Should the AMC warehouse assets (i.e., hold them over a longer period without trying actively to restructure or dispose of them)?
5. What prices should it offer for the assets it purchases?
6. What are the best institutional and operational arrangements for the AMC?
7. Should the government encourage corporate debt workout and restructuring?

Countries are taking different positions in answering these questions; some aspects of these issues which have a direct impact on the success of bank recapitalization are discussed below.

The Purchase Price

In general, the authorities should not buy impaired assets at their book value when recapitalizing the institution because, in effect, this conceals the cost of recapitalization from the public. Such a transaction subsidizes banks, can be used to bail

42Under the Basel Capital Accord, loans carry a 100 percent weight, while cash and government bonds carry a zero or 20 percent weight.
43An exception to the general rule may occur where the government buys banks’ loans to public enterprises. Where these loans have received an explicit or implicit public guarantee, the government may, with justification, choose to buy the loans at close to the book value.

A question arises concerning provisions against assets that are purchased by the government. If the provision is greater than the loss on the sale of the asset, then the bank will benefit from the transaction. If the excess provisions are reversed in the profit and loss accounts, the government may recoup some of its outlays in the form of additional taxes on bank profits. This would happen, for example, when a provision is made for an asset which the government buys at book value.
out owners and managers, and violates the principle of transparency and accountability. A realistic valuation/pricing of assets based on market pricing, sound accounting norms, strong loan classification and provisioning standards, and/or discounted present values, is crucial, as previously discussed in Section III. The rigorous recognition of loan losses is the first and most important element of an effective strategy for dealing with problem assets, because it creates the right incentives for banks to restructure their loans, foreclose on collateral, and precipitate bankruptcy reorganizations. The sellers of problem assets may be persuaded to accept conservative valuations if the asset purchase contract allows them to share unexpectedly good recovery values.

**Weighing the Advantages of Asset Purchases**

Asset purchases by a separate government agency may have a number of advantages that can aid bank recapitalization and restructuring, and if supported by proper incentives for loan workout and recovery efforts, could control fiscal costs. Since banks’ problems are often derived from a deterioration in their loan portfolios, measures directed at the loan portfolios come closest to the source of the problems and may, therefore, be the most efficient form of remedial action, thus enabling banks to quickly resume their normal operations.

Such asset purchases achieve economies of scale in asset management, particularly by centralizing scarce human resources, fostering the development of secondary markets for bank assets, and allowing the bank to focus on managing its good assets during its recovery. Handling assets through a centralized AMC is most appropriate where the banks originally holding the assets have been closed, where open banks holding the assets have no specific expertise in managing them, and where many banks may have claims on the same entity (for instance, a national airline or a major conglomerate). In addition, asset purchases (and recapitalization with public funds generally) can be made conditional upon banks’ participation in debt workouts for borrowers and the achievement of loan recovery performance targets for the assets retained in banks. Indeed, asset purchases/transfers complement a recapitalization package (for reasons already mentioned in Section II) with the allocation of funds between asset purchases and direct recapitalization varying among countries, according to specific institutional circumstances. They can serve as an additional inducement to a bank for compliance with the conditions for a recapitalization package.

Problem assets should be purchased—with bonds or cash—at realistic and fair prices. As stated above, cash and bonds have lower risk weights than loans, and will thus raise the bank’s risk-weighted CAR, as well as change operating incen-

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44There are examples in Asia and elsewhere of assets purchased at inflated prices. However, in Indonesia and Malaysia, the asset management agency has stated that asset purchases are to be based on realistic values.

45Legal deficiencies may also be handled more easily through a centralized agency. See Stone (1998).

46By mid-1996, Mexico had spent two-thirds of its projected net outlays to purchase bad loans and support debtors; only one-third went to recapitalize banks. See Ito and Folkerts-Landau (1996), pp. 114–16. Countries typically purchase bad loans and support debtors when banks’ internal governance is weak and property rights are poorly defended by the legal system.
RECAPITALIZING BANKS WITH PUBLIC FUNDS

tives for banks’ managements. A swap of classified assets whose yields are uncertain for bonds that carry market rates may also reduce bank’s funding costs by decreasing uncertainty. An exchange for cash or bonds, which are negotiable or can be discounted at the central bank, improves bank liquidity and permits banks to make loans or other investments, and to increase income.47

Asset purchases by a separate AMC have several important potential disadvantages, however. First, they do not raise banks’ net worth unless the operation is done at above market prices, which, as discussed above, should be avoided. Asset purchases, thus, do not solve a problem of lack of capital in the banking sector. Second, the government needs to consider the overall cost of this form of assistance, as the expenses it incurs in disposing of the troubled assets may be high and difficult to estimate, depending on the legal and operational environment for loan recovery and the likelihood of being subject to political pressure. Third, asset purchases may provide liquidity if purchased, for example, with cash or negotiable bonds. As with a direct capital infusion, such additional liquidity would need to be managed in order to avoid any potential conflict with the monetary stance. Moreover, as with capital infusions, asset purchases can distort incentives if banks come to expect that the government will bail them out in the future by repeatedly buying their bad assets. Again, the pricing of the assets is the key issue.48

Overall, while one cannot draw universal conclusions, there do seem to be conditions under which the advantages of asset purchases by a separate AMC outweigh the disadvantages. These conditions must include an AMC staffed by financial experts who are both honest and skilled in asset management and sale, with operations that are transparent and cost-effective for the government. The AMC should have, if necessary, special legal powers to expedite loan recovery and loan restructuring and should be constructed as a temporary agency—for handling a special situation, not a permanent arrangement—in order to preserve a good incentive structure.

Should the AMC Buy Assets from All Banks?

Some countries have chosen to acquire and sell assets only from banks that are being resolved by liquidation or merger.49 Other countries also provide assistance to banks that are to remain open by buying their bad assets.50

When the AMC purchases assets from open banks, a potential conflict arises between economizing limited resources and being fair to all banks. Buying bad assets only from troubled banks that are targeted to receive government assistance could affect the survival probabilities of better banks that are still struggling.

47If the assets are purchased at written-down values, and if banks have already provisioned to those values, the sale of the assets should have no direct impact on a bank’s profitability.
48If the centralized AMC is dealing with private banks, it is particularly important to determine transfer prices that do not involve an implicit subsidy, and such determination is quite complex in times of uncertainty.
49Thailand and the United States have taken this approach.
50Indonesia, Japan, Korea, Malaysia, and Mexico have bought bad assets from open banks.
unaided, with a portfolio of bad loans. One way for the government to resolve this
dilemma is to buy some, but not all, of the bad assets of assisted banks; assisted
banks should be left with roughly the same proportion of bad loans as the rest of
the survivors in the industry.51

Should the AMC Buy Only Impaired Assets?
The AMC, given the purpose of restoring banks to good health and of promoting
corporate restructuring should, in general, purchase only impaired assets. Good
assets left with banks, and those that are transferred to banks in exchange for bad
assets, are the means to rehabilitate bank profitability and soundness.

When banks have a choice about which assets to transfer, they may seek to
"cherry pick" and provide just the worst ones. Similarly, if the AMC can choose
its assets, it will choose those where it sees the best possible returns.52 This
problem can, to some extent, be avoided by ensuring that sales are at a "fair" price,
and by defining classes of assets—as "loss" or "doubtful" by the bank's auditors—
which are to be transferred in their entirety.

Should the AMC Warehouse Assets?
There is disagreement about whether the AMC should warehouse assets. Some
believe that selling assets, as soon as they have been catalogued and adequately
serviced in preparation for sale, will establish a floor for asset prices in the economy.
Establishing that floor will provide a turning point for economic recovery. They
argue that warehousing assets prevents price adjustments, particularly where
markets have ceased to function in the crisis, and the overhang of the stored assets
impedes price discovery and market recovery, and prolongs the recession. Finding
the price floor will promote a speedier recovery. Proponents of prompt sale also
point to the danger of asset deterioration while under government control and claim
that restoring assets to the private markets will ensure better maintenance.

Others disagree with this view; they believe that a "fire sale" will accentuate
the depth of the recession. Thus, they argue that assets should be warehoused and
released for sale slowly in order not to flood the market. Warehousing, they assert,
will increase the net present value of the amount the government receives when it
sells the assets and will reduce the taxpayers' ultimate costs. The balance struck
between these two options varies from country to country. The United States was
particularly active in quickly on-selling assets taken over during the savings and
loan crisis, although commentators suggest that the far greater depth of the
markets in the United States means that it is not an appropriate model for other
countries. Among the Asian crisis countries, Thailand has been forceful in quickly
selling assets taken over by the public sector.

51 This was the approach adopted by Sweden. See Ingves and Lind (1997).
52 Where there have been governance problems associated with some assets, the bank may be reluct-
tant to transfer them for fear that these problems would come to light. This has arguably been one of
the reasons for the protracted process of transferring loans to the AMC in Indonesia.
Institutional and Operational Arrangements

There are various institutional structures that will permit the asset management component of the BRA to accomplish its tasks. The institutional arrangements to work out or to recover problem assets could mean several roles for governments—to adequately and flexibly respond to different bank circumstances and market requirements.\(^{53}\) As discussed in Section V, a proactive and centralized role for governments (e.g., government-owned asset management units) could be desirable in some circumstances (e.g., to deal with a large volume of problem assets acquired in mergers, bank closures, and recapitalizations, or to deal with large, legally complicated exposures). In contrast, an enabling role for governments that involves decentralized arrangements (e.g., debt-workout units within banks themselves, or separately capitalized loan recovery and asset management companies) is the most appropriate in many circumstances. For example, most impaired loans where the borrower itself has value as a going concern, and there is a likelihood that the borrower can pay after some financial restructuring, should remain with the originating bank or its successor. However, some small- and medium-sized loans or some insider loans, where the value lies mainly in recovery from underlying assets or collaterals, are often handled by separate loan-recovery companies outside of the banks.\(^{54}\)

Operational aspects of the AMC are largely beyond the scope of this paper; however, they are relevant to the curtailing of government costs in bank recapitalization. In its activities, the AMC will rely on the valuation that has already been made of bank assets, the prognosis for recovery previously made by individual banks, and the identification of banks already deemed eligible for government assistance. The AMC’s tasks are to ensure performance of the loans; take control of the assets, including legal title to collateral; protect real assets from deterioration; improve them if possible; prepare them for marketing; sell them at the best possible price; and go out of business when it has fulfilled its obligations. There are two extreme approaches to asset management. One is to treat each asset separately, selling real property item by item and holding individual loans to maturity while pursuing legal options to force borrowers to service their debts.\(^{55}\) The second, at the opposite end of the spectrum on approaches, is to package the assets and sell them by auction in bulk.\(^{56}\) The two choices reflect opinions about whether the AMC should own the assets or merely act as the agent handling the assets. The latter approach was used by the Federal Deposit Insurance Corporation in the United States, but in other countries the authorities have preferred direct ownership so they can essentially regroup and reorganize the assets before selling them. Again, no clear preference can be determined; different tools are appropriate in different cases.\(^{57}\)

\(^{53}\)See Nyberg (1997).
\(^{54}\)Existing bank-client ties may, in fact, reflect a “cozy” relationship that could impede an aggressive liquidation process.
\(^{55}\)This is the approach adopted in Lithuania as described in Maldeikis (1998).
\(^{56}\)This approach is being used in Thailand, as described in Vichit-Vadakan (1998).
\(^{57}\)For instance, it may be particularly productive to hold and repackage property companies before trying to sell them.
Contractors from the private sector can assist regardless of which approach is adopted by ensuring the performance of the loans. They can design and maintain a computerized database of the assets acquired and an electronic system for tracking loan conditions and dispositions. Investment bankers and other financial experts can design classification criteria for packaging assets, prepare the assets for marketing as securities, and conduct asset auctions.

**Encouraging Loan Workouts**

AMCs and banks can facilitate debt workouts and debt restructuring of potentially viable corporate borrowers. Countries have taken widely disparate approaches to this tool. During the course of bank restructuring, some leave it to the banks themselves and to the private sector. Other countries have been more active in working out and restructuring loans, especially where they believe that the legal system is inadequate in supporting purely private negotiations or where there are market failures. However, if carefully constructed, debt workouts can support recapitalization efforts, whether done through capital injections or asset purchases. They should reduce debt or debt-service burdens and improve borrowers’ abilities to repay their loans, thereby reducing the volume of nonperforming assets on banks’ books without destroying, in the long run, the incentive structure for borrowers to repay their loans.

The enabling role of governments in facilitating loan-workout arrangements can take several forms, and can be an important component of bank recapitalization. Appropriate legal frameworks for bankruptcy and for dealing with collateral are, of course, necessary whatever the institutional mechanisms are for handling problem assets. Possible governmental actions range from the informal and decentralized to the formal and centralized. In the informal decentralized approach the government provides incentives to encourage, and offers guidance on conducting, loan workouts. Taking a more active stance, it might arbitrate disputes among private negotiators. The ultimate interventionist action is to form a centralized AMC and have the government buy banks’ bad debts in order to renegotiate, manage, and sell them. The right choice depends on the seriousness of the problem. In cases of deep insolvency and, ultimately, government ownership of banks, a government-owned AMC (or AMCs) is the likely outcome, while in less severe cases, a privately owned AMC is more likely. In many cases, both types of AMCs are needed to maximize loan recovery, in addition to building up effective loan-workout capacity within banks themselves to deal with normal credit risks.

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58 Japan and the United States have followed this approach.
59 Indonesia, Korea, Malaysia, Mexico, and Thailand have assisted in the restructuring of private debt. The government of Mexico has been particularly active in providing support to households and small and medium-sized businesses. Corporate restructuring is being done privately with government encouragement.
Governments have often played a catalytic role in fostering corporate-debt restructuring, either as a component of bank recapitalization or as a separate complementary policy in times of banking crisis. One framework for debtor-creditor negotiations where the government encourages corporate restructuring is the “London Approach,” which does not have any direct linkage to capital support facilities. When advising the parties or arbitrating disputes between private negotiators, the government can encourage banks or other acquirers to restructure loans, and retain and recover impaired loans of uncertain value through government guarantees under income-maintenance, loss-sharing, stop-loss, or put-back provisions during a specified period. There could also be arrangements for acquirers and sellers to share profits, if assets are sold or recovered for more than a specified amount.

In summary, the choice of institutional and regulatory arrangements for asset management, loan recovery, and corporate-debt restructuring is among the most critical aspects of successful bank recapitalization. The design of these arrangements should ensure realistic valuation of impaired assets, prompt recognition of loan losses, and a balanced and pragmatic approach to asset disposition that is neither too rapid nor too slow, to avoid losses on assets. Specific institutional choices to achieve these goals will depend also on the legal and governance constraints, the nature of the problem assets, and the size and distribution of these assets among banks. One cannot say which specific measures are best or should be adopted; the authorities will need to determine their policies on a case-by-case basis.

VI. Other Actions to Aid Bank Recapitalization

Governments frequently try to aid banks in recapitalizing by reducing their liabilities, improving their income, and granting forbearance. Many of the techniques employed disrupt monetary and fiscal management, distort incentives, and reduce transparency. Because of these efforts, these techniques should be adopted cautiously, if at all. Nevertheless, they are being used in certain countries (see Table 5).

Reducing Liabilities

Rather than increase bank’s assets to match its liabilities, the authorities may seek to reduce its liabilities to the level of its assets. Such a program is, however, often constrained by the comprehensiveness of guarantees already given to depositors and creditors (e.g., in the Asian crisis countries and Mexico), and the legal framework governing their rights under bank-bankruptcy laws. However, even where there is a comprehensive guarantee by the government or the central bank, it may be possible to reduce the size of the bank’s balance sheet by converting liquidity support from

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61 Examples of the former approach include bank recapitalization schemes linked to bank conciliation agreements in Poland, or to debt workout and restructuring in Thailand. See Montes-Negret and Papi (1977), and the capital-support schemes announced by the Ministry of Finance of Thailand on August 14, 1998.


63 These techniques have been used, for example, in Malaysia and in the United States.
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<th>Mexico</th>
<th>Thailand</th>
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<tr>
<td>Assume debts (full guarantee)</td>
<td>Yes.</td>
<td>Yes: regular and call deposits, trusts, bonds.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes: to honor the guarantee.</td>
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<tr>
<td>Reduce claims</td>
<td>The losses imposed on depositors in 16 closed banks were later retroactively fully guaranteed.</td>
<td>Shares, convertible bonds, and subordinated debt.</td>
<td>All shareholders in intervened banks.</td>
<td>Shareholders.</td>
<td>Maturities extended.</td>
<td>For some closed finance companies.</td>
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<td>Other actions</td>
<td>Loan-loss provisioning (LLP) made tax deductible.</td>
<td>No automatic tax deduction for LLP: so banks created the Cooperative Credit Purchasing Co.; loan-loss carry forwards.</td>
<td>Removed limit on tax deductibility for LLP. Put options in P&amp;As for acquiring banks.</td>
<td>LLP already tax deductible; national pension fund bought undervalued shares; lowered reserve and liquidity requirements.</td>
<td>25:75 loss-sharing on bad loans.</td>
<td>Tax deduct LLP, profit &amp; loss-sharing; stop-loss and yield maintenance guarantees for new investors in intervened banks.</td>
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<td>Action</td>
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<td>Forbearance</td>
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<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
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<td>CAR</td>
<td>CAR temporarily lowered to 4%; will gradually increase to 8%; have limited to 1.25% the</td>
<td>(1) Permit international banks to convert to domestic status to lower their CAR to 4%; (2) grace period for compliance with even this low CAR; (3) excessively count deferred taxes and (4) some provisions against substandard loans as capital; (5) can value securities at book not the lower of book or market.</td>
<td>(1) Phased for commercial and merchant banks; (2) for others 8% will rule only in year 2000; (3) loan losses deferred for 3 years for merchant banks; (4) additional provisions required as a result of forward-looking criteria can be phased over 2 years.</td>
<td>Loan classification and provisioning firmed, then relaxed; then firmed again; CAR remains at 8%; supervision tightened; watch lists formalized.</td>
<td>The tightening in 1997 was reversed in 1998: restructured loans now count as performing even when nothing is paid up front; bonds have been reclassified from the trading to hold-to-maturity portfolio; sub. debt counts as base capital and specific provisions as regulatory capital; write down on banks 25% in loss-sharing can be phased over 8 years.</td>
<td>In exchange for restructuring corporate debts; either LCP to be phased in gradually until year 2000 or cost of debt restructuring can be deferred over 5 years.</td>
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<td>Indonesia</td>
<td>Japan</td>
<td>Korea</td>
<td>Malaysia</td>
<td>Mexico</td>
<td>Thailand</td>
</tr>
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</tr>
<tr>
<td>Other</td>
<td>International loan classification and provisioning rules have improved, but recognition of the loss (in excess of provisions) on special-mention and substandard loans can be deferred for up to 4 years; losses on other loans are recognized immediately</td>
<td>Accounting; LCP tightened, but not always enforced; unconsolidated subs. hold bad loans; some banks do not classify or provision until loan is overdue 6 months and they may lend unpaid interest to enable the borrower to keep the loan current; banks have been allowed to revalue property and equities.</td>
<td>Yes: for merchant banks; otherwise accounting is improving and the timetable for phasing in the regulations serves to accelerate the process; ceased including special provisions for NPLs in Tier 2 capital in 1/1999.</td>
<td>For loans sold to Danaharta, banks have up to 5 years to recognize the difference between book value and selling price.</td>
<td>(1) Grace period for loan repayment; (2) the limit on shareholding raised from 10% to 20% of capital; (3) market share limitations were waived; (4) interest rate swap engineered in 9/98 to pay banks higher rates on their treasury securities; (5) banks could pledge non-negotiable FOBAproA bonds as collateral; (6) IPAB notes are negotiable.</td>
<td>No.</td>
</tr>
</tbody>
</table>

Source: IMF staff analysis.

1 The public sector includes the government, the central bank as lender of last resort (LOLR), the deposit insurance corporation (DIC), the asset management company (AMC), the restructuring agency, and any vehicle for recapitalizing banks.
the central bank into bank capital, thereby changing the management incentive structure, particularly as regards the size and riskiness of the bank’s portfolio.

Improving Income

The authorities sometimes assist banks through measures to improve the latter’s income stream, including more lenient tax treatment of banks in various forms, and public sector loans or deposits at below-market interest rates, to improve income and liquidity. Such measures are not transparent and do not adequately address the problem of capital shortage while distorting monetary and fiscal management.

Granting Regulatory Forbearance

Measures of regulatory forbearance adopted in six countries are shown in Table 5. They range from counting certain items as capital in violation of the Basel Capital Accord, to relaxing loan classification and provisioning standards, to phasing in the minimum CAR. Forbearance can be hidden or explicit, and concealed forbearance should be eschewed. Forbearance that allows banks to disguise their losses and recognize them only slowly over time is particularly objectionable. However, in a crisis, one form of explicit regulatory forbearance—phasing in prudential and regulatory standards—can be a useful tool that facilitates recapitalization. The capital adequacy standard can be explicitly and temporarily reduced to some positive number below the desired standard, such as the Basel Committee’s recommended 8 percent or a larger ratio. Banks, under closely monitored conditions, can then be allowed to raise capital over time on a specified and uniformly applied schedule, toward a desirable CAR.

Sometimes countries choose to tighten loan-loss provisioning standards gradually over time, rather than adopt a gradual approach toward desired capital ratios with full compliance of provisioning rules. The gradual approach to desired capital ratios is preferable to the gradual increase in provisioning because it is more transparent. Moreover, the latter can reduce incentives for prompt recognition of asset values that are needed to support loan workout and efficient asset-management arrangements.

VII. Conclusion

Recapitalizing and restructuring banks in the aftermath of a systemic crisis is a complex process that typically requires significant government intervention and takes several years to design and implement. To be effective, it must be carried out in a coordinated, prompt, but carefully prepared manner that reconciles financial

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and human resource needs with resource constraints, and provides an incentive structure that will foster financial stability in the future. It requires careful management both at the strategic level and at the individual-bank level in order to ensure that government investment in banks yields the maximum return and that an efficient and sound banking system emerges at the end of the process.

Achievement of these objectives requires effective institutional and organizational arrangements to make recapitalization and restructuring decisions, to manage impaired assets, and to foster rapid corporate restructuring. The approaches to recapitalization have varied, with countries choosing different mixes of direct capital injections and asset purchases and rehabilitation. In an effective recapitalization process, the two approaches are generally complementary, but a balance between the two approaches (which differs from country to country) is necessary in order to minimize the expected present value of government outlays, net of recoveries.

New investment in banks may also be encouraged by government efforts to aid the restructuring of corporate and consumer debt so that loan quality can improve. For example, lengthening maturities or debt-equity conversions can enable some borrowers, who would otherwise default, to repay their debt and reduce uncertainty in the market.

As restructuring and recapitalization proceed, and as financial stability is restored, the activities of the agencies established to handle these functions will change. They will shift from planning and implementation to preparation for cessation and closure. The BRA, BSA, and AMC will complete their assigned tasks and close down. As their terminations approach, the authorities must prepare to replace the full guarantee, if any, with a limited deposit insurance system, and make sure that the traditional mechanisms for effective corporate governance are firmly in place to preserve financial stability.

APPENDIX I

Glossary

**Asset-backed bonds.** Income from a homogenous bundle of assets can be used to pay the interest on collateralized bonds sold to pay for the purchase of the assets. The bonds may be sold in several tiers depending on the priority of their claim over the income from the assets. The claims with the highest priority have the least risk, and those holding residual claims after all other bond-holders have been paid, are the most risky. Financial institutions have widely used this technique to sell their mortgages to a mortgage banker who securitizes the loans. It is now being adapted for marketing impaired assets. The issuer of the bonds may offer an interest guarantee on some tranches of the debt.

**Asset management company (AMC).** A separately capitalized institution, owned privately, publicly or jointly, that is established for a limited period of time to restructure, manage, and sell the problem assets acquired during bank closures and restructuring. A country may establish one centralized AMC or a number of decentralized ones.

**Bad bank.** The portion of a troubled bank that represents the “bad” assets. Sound assets and often some of the liabilities, particularly the insured deposits, go to the “good bank,” for example, in a purchase and assumption transaction. The nonperforming assets go to the “bad bank,” which typically does not accept deposits from the public. The bank’s principal liability is likely to be the equity of its public or private owner.
Bank restructuring agency (BRA). A lead agency, often created specifically to design and coordinate the implementation of the comprehensive strategy for bank restructuring and recapitalization. This agency coordinates with other government agencies and is accountable to the government for the restructuring process.

Bank support authority (BSA). The subsidiary of the BRA that provides financial support to banks that continue to operate.

Bridge bank. A newly chartered, nationalized bank established and operated by the authorities on an interim basis to acquire the assets and assume the liabilities of failing institutions, until final resolution can be accomplished. The use of bridge banks is generally limited to situations in which more time is needed to permit the least costly resolution of a large or complex institution.

CAMELS rating. The quality rating for banks that typically ranges from 1 for the best banks to 5 for the worst. CAMELS stands for capital, asset quality, management capacity, earnings, liquidity, and systemic risk.

Centralized approach to asset management. One centralized AMC, which is common to all banks and may be government- or privately-owned, recovers value from troubled assets individually or in bulk through debt servicing, debt renegotiations, asset swaps, liquidations, and sales of collateral. The AMC may also be involved in corporate restructuring.

Comfort letter. A letter from the owners and managers indicating their willingness to perform certain actions required by a supervisor, such as being prepared to recapitalize a bank when instructed.

Debt auction. A debtor asks individual creditors to submit bids indicating the percentage repayment they would be willing to accept in settlement of their debts. The debtor then repays those submitting the smallest percentages, probably paying a uniform, cut-off price.

Debt workouts. Agreements between borrowers and lenders to restructure the debts of heavily indebted borrowers. Restructuring a loan for a financially distressed borrower can be more productive for a bank than foreclosing on the collateral or initiating lawsuits to collect on the debt.

Decentralized approach to asset management. Each bank retains financial responsibility for working out its problem assets. Its workout unit may be run as a separate department of the banks or as a wholly-owned subsidiary.

Due diligence. The on-site inspection of the books and records of a failing institution. Before an institution’s failure, the authorities invite potential purchasers to the institution to review pertinent files so they can make informed decisions about the value of the failing institution’s assets. Such potential purchasers must sign a confidentiality agreement. In addition, contractors may be hired to perform due diligence on assets that are earmarked for multi-asset sales initiatives.

Essentiality. An exception to the financial criteria that should usually govern eligibility for recapitalization with public funds may be made when a bank provides essential, irreplaceable services to the economy and/or is too large to be closed.

Fit-and-proper test. An evaluation of the competence, integrity, qualifications, and experience of the owner, senior managers, and directors of a bank. This evaluation involves background checks on whether previous activities, including adverse regulatory or judicial decisions, raise doubts concerning competence, sound judgment, or honesty.

Franchise value. The franchise value is the discounted present value of the bank’s future profits. Thus, a bank with zero net worth could have a positive franchise value, which an acquirer would be willing to buy. Deposits that can be invested at a positive profit have a positive franchise value.

Good bank. A bank whose bad assets have been removed.

Income (or yield) maintenance agreement. A resolution method used by the authorities to guarantee a market rate of return on certain assets of troubled banks. For example, the authorities may pay the holder the difference between the current yield on assets and the bank’s average cost of funds. These agreements can also be used to facilitate mergers and Purchase and Assumptions (P&As) between troubled banks and healthy institutions.
**Intervention.** The intervention may take several forms: an insolvent bank may be closed; an undercapitalized bank may be nationalized, placed in conservatorship, or given capital assistance while under close supervision.

**Loss-sharing agreement.** An agreement between the acquiring bank and the authorities regarding the sharing of losses in a failed bank. Loss sharing aims to sell as many assets of a failed bank as possible to the private sector and align the interests and incentives of the acquiring bank and the authorities so that the assets are well-managed and maximum recoveries are obtained. Under loss sharing, the authorities agree to absorb a significant portion of the loss—typically 80 percent—on a specified pool of assets while offering even greater loss protection in the event of financial catastrophe. The acquiring bank is liable for the remaining portion of the loss.

**Memorandum of understanding (MOU).** A written statement indicating agreement between a bank and its supervisor that the bank perform certain actions.

**Noncumulative preferred shares.** A perpetual component of Tier 1 capital that provides the owners with special voting rights as well as a fixed amount of dividends, where the bank's financial results permit.

**Open-bank assistance.** A term used especially in the United States to indicate financial assistance to a bank that will be allowed to continue in business. That bank may be briefly closed and its shareholders wiped out to be reopened as a temporary bridge bank or, as in the case of Continental Illinois National Bank, shareholders may be allowed to retain some residual ownership rights.

**Options.** A call option gives the right, but not the obligation to purchase an asset at an agreed-upon price at a specified date (European option), or within a specified period (American option). A put option conveys a similar right, but not the obligation to sell.

**Profit sharing.** Gives the government an opportunity to share in the upside potential when the economy recovers. A government-owned asset management company (AMC), for example, may lend funds to a private sector acquirer to enable him to purchase restructured assets. In addition to paying interest, the acquirer may agree to convey, for instance, 20 percent of the profits he earns on the acquisition, to the AMC.

**Purchase and assumption (P&A).** An acquiring bank purchases the assets and assumes the liabilities of a failed bank. The transaction may cover all of the assets (whole bank P&A), or the best part of the assets (“good bank” P&A).

**Put-back provision.** A provision under which an assuming institution has the option of returning to the authorities, within a specified time period, certain assets that have been transferred to the acquiring institution.

**Risk-weighted capital adequacy ratio.** The Basel Capital Accord assigns risk-weights to on-and off balance sheet exposures, according to broad categories of relative riskiness. The Accord sets minimum capital ratio requirements for internationally active banks of 4 percent for Tier 1 capital and 8 percent for total capital in relation to risk-weighted assets.

**Securitization.** The AMC can hire an expert investment bank to set criteria for packaging a bundle of impaired assets into a relatively homogeneous group. Asset-backed bonds are then sold to finance the asset purchase. These assets will be serviced either by the AMC or by a company expert in this task and the income received will be used to pay the interest owed on the bonds.

**Stop-loss agreement.** A “stop-loss” agreement imposes limits on the acquirer’s exposure to unanticipated losses on the shared loss-assets. If asset losses exceed the authorities’ best estimate of the loss, their percentage coverage is then increased, for instance, to 95 percent, and the acquiring bank’s exposure is reduced to 5 percent of the loss.

**Triage.** The division of institutions between those that need no help, those that are worth helping, and those that are beyond help.

**Warrants to purchase.** Securities that give their holders the right to purchase a certain number of the shares of common stock in a corporation, at a pre-set price and under pre-defined conditions.

**Yield maintenance agreement.** See income-maintenance agreement.
RECAPITALIZING BANKS WITH PUBLIC FUNDS

APPENDIX II

Figure A1. Institutional Framework: Indonesia

Figure A2. Institutional Framework: Japan

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Figure A3. Institutional Framework: Korea

Source: Presentation for the SEANZA Forum of Banking Supervisors, November 1998; IMF staff analysis.

Figure A4. Institutional Framework: Malaysia

Sources: Presentation for the SEANZA Forum of Banking Supervisors, November 1998; IMF staff analysis.
RECAPITALIZING BANKS WITH PUBLIC FUNDS

Figure A5. Institutional Framework: Mexico

(a) Before 1999

Government

Bank of Mexico
(clear central bank)

FOBAPROA
deposit insurer and
BSA

Ministry of Finance

Debt Restructuring Programs
UDIs, FINAFE, FOPYME

National Banking and
Securities Commission
(The supervisory agency)

Valuacion y Venta
del Ahora
(VVA)
sells FOBAPROA's assets

AMC
purchases bad loans

[trust fund]
[trust fund]

(b) In 1999

Government

Secretariat of Finance
and Public Credit
(SHCP or MOF)

Bank of Mexico
(clear central bank)

Asset Recovery
Commission
(CRB)

Savings Protection
Agency (IPAB)
(deposit insurer)

National Banking and
Securities Commissioner
(the supervisor)

VVA
to sell FOBAPROA's
(former DIA) assets

Source: IMF staff analysis.
Figure A6. Institutional Framework: Sweden

Source: IMF staff analysis.

Figure A7. Institutional Framework: Thailand

Source: IMF staff analysis.
RECAPITALIZING BANKS WITH PUBLIC FUNDS

Figure A8. Institutional Framework: U.S. Federal Deposit Insurance Corporation Model

Source: IMF staff analysis.

Figure A9. Institutional Framework: U.S. Resolution Trust Corporation Model

Source: IMF staff analysis.
REFERENCES


Exchange-Rate-Based Stabilization:  
A Critical Look at the Stylized Facts

A. JAVIER HAMANN

Do exchange-rate-based stabilizations generate distinctive economic dynamics? To address this question, this paper identifies stabilization episodes using criteria that differ from those in previous empirical studies of exchange-rate-based stabilizations. We find that, while some differences can be detected between exchange-rate-based stabilizations and stabilizations where the exchange rate is not the anchor, the behavior of important variables does not appear to differ—especially output growth, which is good in both cases. There is also no evidence that fiscal discipline is enhanced by adopting an exchange rate anchor, or that there are any systematic differences in the success records of stabilizations that use the exchange rate as a nominal anchor and those that do not. [JEL E31, E63]

In recent years, several articles have identified a set of empirical regularities that arise during exchange-rate-based stabilization (ERBS) in high inflation countries. These empirical regularities are presumably not observed when the inflation stabilization strategy does not rely on the use of the exchange rate and are, thus, commonly referred to as the ERBS “syndrome.” The main features of the syndrome include a boom-bust cycle (as opposed to the initial recessionary effects of money-based stabilizations); a consumption (and sometimes also an investment) boom; a pronounced real exchange rate appreciation; and worsening trade

*The author would like to thank Timothy Lane, Enrica Detragiache, Martin Uribe, and an anonymous referee for their helpful comments, and Sibabrata Das for valuable research assistance.

Calvo and Végh (1994) and Reinhart and Végh (1994) lend further support to the notion of an ERBS syndrome.
and current account balances. In addition, the literature points out that there is a particularly high incidence of failure among ERBS in high inflation countries.

It is quite surprising that, although the identification of an ERBS syndrome was based on a relatively small sample of countries from Latin America and Israel and its relevance for other countries has not been studied, it has nonetheless inspired a growing theoretical literature. There are also potentially serious methodological problems with the way in which the comparison of ERBS with other stabilizations has been usually carried out. Most importantly, there are inconsistencies in the timing of ERBS and the typical control group of money-based stabilizations (MBS), as the former presumably start when the exchange rate is actually pegged whereas the latter are assumed to begin when they are announced. In addition, there is no obvious reason why the control group against which the ERBS have been compared should be confined to MBS; instead it should include all non-ERBS, that is, a broader class of programs that includes those where no strict monetary or exchange rate rule was pursued.

This paper looks at the stylized facts of ERBS and other stabilization plans where the exchange rate was not the anchor (OS), trying to correct some of the problems mentioned above. To this end, the paper follows earlier work by Ball (1994) and Easterly (1996) and constructs a set of inflation stabilization episodes on the basis of a simple numerical rule. The timing of all inflation stabilizations, ERBS and otherwise, is, thus, based on a common criterion. In addition to the elements of the ERBS syndrome, the paper looks at the issue of financial discipline, which, according to a widely held view, is enhanced by the use of the exchange rate as an anchor. It must be stressed, however, that the paper is mainly descriptive: it identifies patterns in the data and examines their robustness, rather than carrying out formal tests of competing hypotheses. In this sense, the paper should be viewed as a first attempt at establishing stylized facts on the basis of a rule-based selection of inflation stabilization episodes, leaving formal testing of other important issues for further research.

The results are not totally supportive of the ERBS syndrome described in the literature. While differences in the behavior of some macroeconomic variables between ERBS and OS were detected, there is no evidence of a “recession now vs. recession later” trade-off between ERBS and OS; in fact, growth performance during stabilization is good in both groups, as had been found by Easterly (1996). There is also no evidence that fiscal discipline is enhanced by the adoption of an exchange rate anchor, or that there are any systematic differences in the records of success of ERBS and OS.

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3 For example, a control group of only six MBS programs is used in Kiguel and Liviatan (1992) and five MBS programs in Calvo and Végh (1994) and Reinhart and Végh (1994).

4 A key assumption made in the papers that try to explain the ERBS syndrome is that the selection of the nominal anchor is an exogenous decision. While this paper does not test formally the hypothesis that anchor selection may be endogenous, it tries to shed some light on the issue by trying to identify systematic differences in the behavior of key macroeconomic variables in pre-stabilization years.
I. Identifying Stabilization Episodes

The selection of the inflation stabilization episodes used in this study is based on the application of some rules to a data set of annual inflation rates for the period 1960–1997 for a group of 143 countries.5 The alternative to a rules-based method for selecting episodes would be a comprehensive review of the history of those countries, aimed at identifying periods in which governments put in place anti-inflation economic programs. This alternative route would necessarily entail some controversial judgements regarding, for instance, whether to exclude programs that could not be considered serious attempts at disinflation, or programs that were abandoned soon after they were implemented. Furthermore, in most cases, identifying the precise timing of stabilization episodes could be equally arbitrary. It is not always the case that inflation stabilization programs have a clearly identifiable start date, with the exceptions being perhaps those in which the exchange rate played a central role and its future path was announced along with other measures.6 It is often the case, moreover, that inflation is successfully brought down after more than one attempt and, even in those cases, it is not entirely clear when a given stabilization plan ended and the next one began.

Another alternative would be to rely on existing work documenting stabilization programs in high inflation countries. But those studies are not likely to provide a comprehensive account of stabilization episodes. One of the purposes of the present study is to examine a range of inflation stabilization episodes that goes beyond the set that has been well documented in the literature. Furthermore, doubts about the precise timing of the stabilization programs and consistency across countries of the methodology for selecting relevant episodes are not likely to be resolved by relying on a survey of existing studies of stabilization experiences. However, it must be acknowledged that, whereas specifying a rule for selecting inflation stabilization episodes simplifies the task of identifying episodes enormously and does not discriminate against programs that have not been documented, it does not remove subjectivity completely from the analysis. Rules will be unavoidably arbitrary but the patterns detected under one set of rules can be checked for robustness with respect to small changes in the eligibility criteria.

Ball (1994) and Easterly (1996) have used rules for the identification of inflation stabilization episodes. Building upon earlier work by Bruno and Easterly (1995), Easterly (1996) defines a stabilization episode as a movement from an “inflation crisis” to a “non-crisis” period where the former is defined as a period of at least two consecutive years of inflation above 40 percent and the latter as a period of at least two consecutive years with inflation below 40 percent. The two-year minimum is used to eliminate spikes in inflation due purely to one-time price shocks such as changes in key import prices, devaluations, or price liberalizations. The 40 percent threshold level is found by Bruno and Easterly (1995) to be useful.

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5This represents a sub-set of countries for which the IMF publishes data which excludes the eastern European countries and the former republics of the Soviet Union.

6Even in those cases, other stabilization policies may have been put in place before the announcement of a path for the exchange rate, thus obscuring the timing of stabilization.
in discriminating between periods of very high inflation and moderate to low inflation. To establish the timing of stabilizations, Easterly defines the peak year during the crisis period as "year 0," or the stabilization year, and the year after the peak as the first post-stabilization year.

Easterly found 28 stabilization episodes, shown under Criterion (1) in Table 1, and his rule could be considered a relatively stringent criterion for the selection of stabilization episodes. Notably, the list excludes a number of well-documented, albeit mostly failed, stabilization attempts, including Argentina and Chile's tablitas of the late 1970s, and the heterodox programs of Argentina, Brazil, and Peru in the mid-1980s. The sample also excludes several programs in Africa. In a deliberate attempt to produce a larger sample, three alternative rules were used here to identify stabilization episodes, all of them based on the requirement that, prior to stabilization, inflation remained at or above 40 percent for at least two years:

- Criterion (2): stabilization occurs when inflation is brought down below 40 percent and remains below 40 percent for at least another year.
- Criterion (3): stabilization occurs when the inflation rate is lowered by at least one-quarter the first year and remains below the pre-stabilization level for at least another year.
- Criterion (4): stabilization occurs when the inflation rate is lowered by at least one-half the first year and remains below the pre-stabilization level for at least another year.

The results of applying the three rules to the data are shown under Criteria (2)-(4) in Table 1. Criterion (2) produces 34 stabilization episodes, of which 22 coincide with those in Easterly's sample. The timing of stabilization, however, tends to be delayed by a year in most cases, reflecting in part the fact that Easterly's selection was based on end-of-period inflation whereas in this paper average inflation was used. The fact that this rule does not produce a very large number of episodes shows the discriminating power of the 40 percent threshold, since no minimum reduction in inflation is required. A potential shortcoming of this criterion, however, is that it could pick up cases in which inflation may have been lowered from slightly over 40 percent to slightly less than 40 percent, which would not represent economically mean-

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7 The following episodes were identified but are not included in Table 1: Nicaragua 1981 (as a large share of prices were controlled by the government); and Afghanistan 1992, Equatorial Guinea 1986, Guinea Bissau 1982, and Somalia 1991 (either because of unreliable inflation data or lack of data on other variables also studied in this paper).

8 Strictly speaking, the rule produced 28 episodes. Six additional episodes, denoted by italics in Table 1, were identified when the threshold was lowered to 35 percent in an attempt to capture "near misses." This exercise was also carried out for Criteria (3) and (4).

9 The reason for this was the availability of data: there was a relatively large number of countries for which the series of end-of-period inflation rates contained missing observations. As a result, annual average inflation rates were used which, admittedly, will tend to push forward the stabilization date by one year. The significance of this point is discussed later.

10 Since the "stabilization year" is set here as the first year in which a meaningful reduction in inflation takes place, and not as the peak inflation year as in Easterly (1996), dates for Criterion (1) in Table 1 have been adjusted to make them comparable to those obtained for Criteria (2)-(4).
Table 1. Stabilization Episodes

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<tr>
<td>Uruguay 4</td>
<td>1991</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Venezuela</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zambia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total number of episodes</td>
<td>28</td>
<td>34</td>
<td>51</td>
</tr>
<tr>
<td>Number of Easterly (1996) episodes</td>
<td>28</td>
<td>22</td>
<td>28</td>
</tr>
<tr>
<td>Preceded by IMF arrangements</td>
<td>21</td>
<td>25</td>
<td>38</td>
</tr>
</tbody>
</table>

Sources: Easterly (1996), IMF *International Financial Statistics* (IFS), and national sources.

1 Date of nearest IMF arrangement, prior to earliest stabilization date among criteria (1)–(4).

The former is defined as at least two years of inflation above 40 percent and the latter as at least two years of inflation below 40 percent.

(1) First year after peak inflation in a transition from a high inflation to a low inflation period. The former is defined as at least two years of inflation above 40 percent and the latter as at least two years of inflation below 40 percent.

(2) First of at least two years of inflation below 40 percent, following at least two years of inflation above 40 percent.

(3) Year of at least 25 percent reduction in the inflation rate from a level of at least 40 percent, preceded by at least another year of inflation above 40 percent. Inflation in the second year of stabilization must remain below its level in the last pre-stabilization year.

(4) Year of at least 50 percent reduction in the inflation rate from a level of at least 40 percent, preceded by at least another year of inflation above 40 percent. Inflation in the second year of stabilization must remain below its level in the last pre-stabilization year.

In fact, only two marginal cases were picked up and were dropped from the sample: Israel 1976 and Guinea 1982.

Unlike Criterion (2), Criterion (3) does not impose a uniform ceiling on post-stabilization inflation but requires a reduction of at least one-quarter in inflation in the first year of stabilization. This proved to be a significantly less restrictive criterion, as it produced 51 stabilization episodes, including all 28 found by Easterly (although 17 of them are dated a year later). This criterion also picks up the well-
known episodes not captured by Easterly’s rule, mentioned earlier.\textsuperscript{11} Criterion (4), which requires halving inflation as a minimum, produced 36 episodes, including 22 of the 28 identified by Easterly. It was decided, therefore, to carry out a comparative study of the stylized facts that would arise from the two samples produced by the most stringent and loosest criteria: Easterly’s and Criterion (3).

Since the episodes contained in the two samples to be used in this study were selected exclusively on the basis of inflation performance, some additional information that stabilization programs were actually put in place in those cases is needed in order to rule out the possibility that the selected episodes represent positive supply shocks. One way to deal with this issue is to check for the existence of IMF-supported programs during a period of, say, up to two years prior to the stabilization date identified in Table 1. Of the 55 episodes listed in Table 1, 41 were preceded by, or coincided with, an IMF-supported program. Moreover, 38 of the 51 episodes identified by Criterion (3) were preceded by or coincided with an IMF-supported program, and there is further evidence that in most of the remaining 13 cases, stabilization programs were put in place: Argentina 1980 actually represents its \textit{tablita} experiment, which ran from December 1978 to February 1981; Brazil 1999 is President Collor’s stabilization plan of 1990–91; Indonesia’s “stabilization and rehabilitation” program, started in 1966, is documented by Azis (1994); the Israeli stabilization plan has been analyzed extensively—Bruno and Piterman (1988) is the first of several studies dealing with the Israeli stabilization; Iceland’s two stabilization plans are reviewed by Andersen and Guðmundsson (1998); and Ghana’s strategy to mop up excess liquidity in 1978 is documented by Sowa (1993). Other episodes are not well documented in the literature but clearly constitute bona-fide stabilization programs: Lebanon’s 1993 stabilization is part of the economic reconstruction plan started in 1991 following the Taif peace treaty, and Ecuador 1994 reflects the efforts of that country’s authorities to bring down inflation through the active use of the exchange rate as a tool to anchor expectations about inflation. Thus, of the 51 episodes identified associated with Criterion (3) there are only 4 for which there is no independent evidence of the adoption of a stabilization plan: Guinea Bissau 1993, Lebanon 1988, Sierra Leone 1992, and the Syrian Arab Republic 1988.

There are other problems associated with the identification of stabilization episodes based exclusively on the actual behavior of inflation. First, since the selected stabilization episodes are those for which a given reduction in inflation is actually observed, it follows that the resulting sample is composed mainly of programs that enjoyed some degree of success. Short-lived programs that did not manage to make a significant dent in average annual inflation would not have been picked up. Second, the rules may be picking up the delayed effects of programs that pursued more than one objective at a time or, more likely, programs that pursued a sequence of events, such as restoration of external balance first, and only subsequently a reduction in inflation. Thus, either by pushing forward the timing

\textsuperscript{11}Table 1 shows a stabilization date of 1975 for Chile under Criterion (3) and 1977 under Criterion (4). In fact, according to Criterion (3) a “stabilization” occurred every year in Chile in the period 1975–78, but only the first year of this continuum is shown on Table 1. Under Criterion (4) this stabilization period begins in 1977.
of stabilization, or by focusing only on relatively successful episodes, it is likely that the sample of episodes identified here may be biased in the sense of being associated with a more positive economic outlook around stabilization time (that is, higher growth, better external accounts, etc.). While no systematic attempt to correct these potential biases is made in this paper, the issue is informally taken into account when interpreting the results.

In the following sections, Easterly’s sample, which will be denoted as Sample 1, and the sample arising from using Criterion (3), which will be referred to as Sample 2, will be used. It is hoped that a comparison of the results generated by each of these samples will shed some light about whether the identified stylized facts are robust to changes in the precise statistical definition of a stabilization episode. In particular, the fact that 17 of the 28 episodes shared by both samples are dated differently will provide a robustness check against the rule followed for timing stabilization episodes.

II. Nominal Anchors and Stylized Facts

Sample 1 was split into ERBS and OS in Easterly (1996). ERBS were identified as cases in which the exchange rate was fixed as part of the program and the country had current account convertibility. Of the 28 programs in Easterly’s sample, 9 were found to be ERBS. For Sample 2, the identification of ERBS was based on a two-stage procedure. First, information was obtained from the empirical literature on ERBS, as well as from IMF staff reports in the cases in which IMF-supported programs were in place at the time of stabilization. This first step led to the identification of 13 ERBS. For each of the remaining programs, the joint condition of a fixed exchange rate and current account convertibility was checked; this check did not reveal any additional ERBS. Table 2 shows the breakdown of Samples 1 and 2 into ERBS and OS. Since the stabilization dates in Samples 1 and 2 were obtained using a mechanical rule, the last column of Table 2 provides the dates in which exchange rates were actually pegged for the ERBS. The rules-determined and historical dates coincide in only 3 of the 13 ERBS in Sample 2. The historical date precedes the rules-determined date by one year in seven cases, and by two years in the remaining three cases.

The following subsections study the behavior of several macroeconomic variables during a seven-year window—from \( t-3 \) to \( t+3 \), where \( t \) is the stabilization year. As a rule, the sample median, and a 95 percent confidence interval around it, are shown for each variable. Median was selected over the mean because sample means are in most cases seriously affected by a few extreme values; as a result, standard deviations and, thus, confidence intervals around the means tend to be extremely wide, rendering comparisons of means largely meaningless.

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12 Due to the absence of current account convertibility, the stabilization programs in Bangladesh 1975 and Ghana 1984 were not considered ERBS.

13 It must be stressed here that Easterly’s (1996) study focuses on growth and, unlike this paper, does not look at the behavior of the other variables associated with the ERBS syndrome. In this sense, Sample 1 is an extension of that used by Easterly.
<table>
<thead>
<tr>
<th>Country</th>
<th>Easterly (1996) Sample Exchange Rate Anchor</th>
<th>Alternative Sample Exchange Rate Anchor</th>
<th>ERBS Historical Dates</th>
</tr>
</thead>
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<tr>
<td>Argentina 1</td>
<td>1977</td>
<td>Yes</td>
<td>1979</td>
</tr>
<tr>
<td>Argentina 2</td>
<td>1980</td>
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<td>1985</td>
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<tr>
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<td>1986</td>
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<td>1965</td>
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</tr>
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<td>Costa Rica</td>
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<td>1986</td>
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</tr>
<tr>
<td>Peru 2</td>
<td>1991</td>
<td></td>
<td></td>
</tr>
<tr>
<td>São Tomé &amp; Príncipe</td>
<td>1992</td>
<td></td>
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<td>Sierra Leone 2</td>
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</tr>
<tr>
<td>Somalia 1</td>
<td>1981</td>
<td></td>
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</tr>
<tr>
<td>Somalia 2</td>
<td>1985</td>
<td></td>
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</tr>
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Financial Discipline

The key argument in favor of selecting an exchange rate anchor during disinflation relates to its ability to strengthen domestic financial discipline. The argument is that a credible commitment to a highly visible variable such as the exchange rate (as opposed to an inflation or money target) will be a relatively more effective way to eliminate an “inflation bias” in wage and financial contracts, and would provide a better incentive to produce the fiscal adjustment needed for the sustainability of low inflation and the viability of the peg itself. The theoretical merits of this argument aside, the empirical evidence on the ability of pegged exchange rates to strengthen financial discipline is mixed. After controlling for several factors, Edwards (1993) finds that countries that pegged their exchange rates at the beginning of the 1980s were financially more responsible than those with a more flexible exchange rate regime. However, in various studies Tornell and Velasco (1995a, 1995b, 1998) find no evidence in support of the view that the adoption of an exchange rate anchor imposes stronger fiscal discipline. Tornell and Velasco (1995b) show that during the 1980s, fiscal discipline was stronger among sub-Saharan countries with flexible exchange rate regimes than among those with fixed exchange rates (the franc zone countries); while Tornell and Velasco (1998) and (1995a) find that fiscal adjustment was stronger, and occurred more often, in money-based stabilizations (MBS) than in ERBS in Latin America.

14See, for example, the chapter on exchange rate regimes and financial discipline in Aghevli, Khan, and Montiel (1991).
EXCHANGE-RATE-BASED STABILIZATION: A CRITICAL LOOK AT THE STYLIZED FACTS

The issue of financial discipline is discussed here in terms of the behavior of inflation pre- and post-stabilization and the evolution of fiscal and monetary variables. A comparison of the actual reduction in inflation between ERBS and OS is, in principle, not a valid way of judging the relative merits of these strategies in reducing inflation (especially when no control is made for the paths targeted for the exchange rate and money). Nonetheless, some (weak) results in favor of the financial discipline effect of exchange rate anchors emerge from Figures 1 and 2. According to both samples, inflation in the pre-stabilization years is higher in ERBS than in OS (at least 20 percentage points in the level of inflation), and yet post-stabilization inflation is lower in ERBS, although the difference is relatively small. And three years after stabilization, inflation is lower in ERBS than in OS in both samples. As before, however, differences in inflation performance between ERBS and OS are not statistically significant. Differences across regimes in the behavior of money growth rates are less clear; in particular, there is almost no difference in the average of median rates of money growth in the post-stabilization years, suggesting that real money balances grow faster after stabilization in ERBS than in OS.

The bottom panels of Figures 1 and 2 provide no evidence consistent with the view that fiscal discipline is stronger in ERBS. Fiscal adjustment in year \( t \) is stronger in ERBS in Sample 1 (1¼ p.p. of GDP vs. ¼ p.p. in OS) but weaker in Sample 2 (½ p.p. of GDP vs. 1½ p.p. in OS). When the cumulative change in the fiscal balance from \( t-1 \) to \( t+1 \) is considered, however, adjustment under OS is stronger (1¼ p.p. of GDP vs. ½ p.p. in ERBS in Sample 1; 1 p.p. of GDP vs. −¼ p.p. in ERBS in Sample 2). Fiscal balances deteriorate in the second or third post-stabilization years in all cases, but in no case do fiscal balances in year \( t+3 \) fall below their level in year \( t-1 \). To the extent that the difference in fiscal balances between years \( t+3 \) and \( t-1 \) can be considered as an indicator of the “durability” of the initial fiscal adjustment, better results are obtained in OS.

Important differences in pre-stabilization patterns of fiscal balances exist between ERBS and OS. Clearly, pre-stabilization fiscal deficits tend to be smaller in ERBS than in OS (about 3½ percent of GDP in ERBS vs. 5 percent of GDP in OS in both samples), suggesting that the prevailing fiscal situation may be a factor in the selection of an anchor during stabilization. On the other hand, adjustment in the runup to stabilization (from \( t-3 \) to \( t-1 \)) is not necessarily greater under one type of program: the improvement in fiscal balance is larger in ERBS in Sample 1, but (slightly) larger in OS in Sample 2.

The ERBS Syndrome

As mentioned earlier, the main stylized facts of the ERBS syndrome identified in the literature are: a boom-bust cycle (as opposed to the initial recessionary effects

\[ \text{Notice that in the cases of inflation and money growth the charts show a transformation, } \frac{X}{1+X}, \text{ rather than the actual level of the variable in order to prevent the width of the associated confidence interval from obscuring the changes in the median.} \]

\[ \text{The abbreviation “p.p.” is used to denote “percentage points.”} \]
Figure 1. Sample 1: Inflation, Monetary and Fiscal Accounts

Sources: IFS, national sources, and author’s estimates.

The following transformation was used: $x = X(1 + X)$. 

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Figure 2. Sample 2: Inflation, Monetary and Fiscal Accounts

ERBS: Inflation

OS: Inflation

ERBS: Growth of M2

OS: Growth of M2

ERBS: Central government balance
(in percent of GDP)

OS: Central government balance
(in percent of GDP)

Sources: IFS, national sources, and author’s estimates.

1The following transformation was used: \( x = X(1 + X) \).
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of money-based stabilizations); a consumption (and sometimes also an investment) boom; a pronounced real exchange rate appreciation; and worsening trade and current account balances.

Figures 3 and 4 show the behavior of GDP and per-capita GDP growth around stabilization for both ERBS and OS in both samples. There appears to be no evidence from either sample of a “recession now vs. recession later” trade-off involved in the selection of nominal anchors. A slowdown in growth does occur in ERBS, as GDP growth rates decline by about 1 1/2 p.p. two or three years after stabilization; this trend is clearer when per capita GDP growth rates are considered. But there is no evidence of a recession during (or following) stabilization in OS. Despite relatively wide confidence intervals in some cases, Figures 3 and 4 show that growth performance improves during inflation stabilization and its immediate aftermath both in ERBS and OS.

The behavior of private consumption (as a percentage of GDP) does differ in ERBS and OS, as shown in Figure 5, but the key differences are statistically significant only in Sample 1. The top left panel of Figure 5 shows a sizeable (nearly 3 p.p. of GDP) and statistically significant increase in the private consumption-to-GDP ratio in the stabilization year, followed by an additionally (albeit smaller and not statistically significant) increase in year \( t+1 \). The bottom left panel shows similar, but not statistically significant, results for Sample 2. Nothing remotely similar to this result can be found in the case of OS in either sample. Thus, there seems to be some statistical support to the “consumption boom” element of the ERBS syndrome described in the literature.

Investment behavior in the post-stabilization years also tends to differ between OS and ERBS, as shown in Figure 6. In ERBS investment does not deviate considerably from its value in year \( t \) during the post-stabilization years, except for a 1 p.p. of GDP fall in year \( t+3 \) in Sample 2. The picture is quite different in OS, where an increasingly positive deviation can be detected, especially in Sample 1 (investment in year \( t+3 \) is 3 p.p. of GDP higher than in year \( t \), although the difference is not statistically significant). In Sample 2, the differences between investment in years \( t+2 \) and \( t+3 \) and its value in year \( t \) are smaller, but statistically significant. In the pre-stabilization years, the clearest development is a decline of at least 1 p.p. of GDP in investment in year \( t-1 \) in all cases; only in ERBS in Sample 2 does investment decline for two years prior to stabilization (the cumulative decline is 2 1/2 p.p. of GDP). Thus, there is no evidence of an investment boom in ERBS, and instead, there is weak evidence suggesting that investment falls somewhat in the runup to stabilization in all cases. There appears to be somewhat stronger evidence suggesting that investment recovers more sluggishly or not at all in post-stabilization years following ERBS.

Moderate differences in the behavior of the current account balance in pre- and post-stabilization years seem to exist between ERBS and OS (Figure 7). In the case of ERBS, Samples 1 and 2 show changes in different directions in current account balances in the stabilization year and a deterioration following stabilization, although this trend is not statistically significant. In OS, on the other hand, there is no change in the median current account balance in the stabilization year and no clear pattern in post-stabilization years. Furthermore, the behavior of the current account balance
Figure 3. Sample 1: Growth of GDP and Per Capita GDP During Disinflation

Sources: IFS, national sources, and author's estimates.
Figure 4. Sample 2: Growth of GDP and Per Capita GDP During Disinflation

Sources: IFS, national sources, and author’s estimates.
Figure 5. Private Consumption During Disinflation
(In percent of GDP)

Sources: IFS, national sources, and author's estimates.
Figure 6. Investment During Disinflation
(In percent of GDP)

ERBS (Sample 1): Investment
(deviations from value in year t)

OS (Sample 1): Investment
(deviations from value in year t)

ERBS (Sample 2): Investment
(deviations from value in year t)

OS (Sample 2): Investment
(deviations from value in year t)

Sources: IFS, national sources, and author’s estimates.
Figure 7. The Current Account During Disinflation
(In percent of GDP)

Sources: IFS, national sources, and author’s estimates.
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provides another example of important differences in pre-stabilization dynamics, which may be indicative of endogeneity of anchor selection: the median deviations from values recorded in the stabilization year indicate an improvement in current account balances in ERBS (between years $t-2$ and $t-1$ in Sample 1 and between years $t-3$ and $t-1$ in Sample 2), but only minimal changes in OS.

Figure 8 shows some additional, but weak, evidence in support of one of the elements of the ERBS syndrome. The trends exhibited by the real exchange rate differ markedly between ERBS and OS: real exchange rates tend to appreciate before and after stabilization when the exchange rate is used as an anchor, but tend to depreciate before and after stabilization in OS. These changes are not statistically significant, however. Interestingly, there is a sizeable (about 10–20 percent) depreciation in year $t-2$ in all cases, which is consistent with the notion of restoration of external equilibrium prior to inflation stabilization discussed earlier. Quite clearly, in the ERBS the real appreciation is not only a post-stabilization phenomenon; in fact, for this to be the case ERBS would have had to be dated two years too late on average. Otherwise there is room to ponder whether policymakers may not have been managing the exchange rate with the purpose of lowering inflationary expectations for some time before they adopted a publicly-announced ERBS. There is also the possibility that, before the exchange rate was used explicitly as an anchor, tight monetary policy may have led to an appreciation before it caused a reduction in (average) inflation. On the other hand, for OS there is no clear evidence of real appreciation prior to inflation stabilization, except for a sizeable but not statistically significant appreciation in year $t-1$ in Sample 1.

Using a sample similar to those used by the studies that first identified the ERBS syndrome, Gould (1996) found that the choice of nominal anchor is endogenously determined by the prevailing level of international reserves. Figure 9 provides some evidence of a possible systematic difference in the behavior of reserves prior to stabilization in ERBS and OS. Between years $t-3$ and $t$ gross international reserves are generally higher in ERBS than in OS (3½ months of imports vs. 1½ in Sample 1; 4½ months of imports vs. 2 months in OS in Sample 2). It must be stressed, however, that confidence intervals are quite wide in the case of ERBS and these differences in reserve levels are not statistically significant.

The difference in reserve holdings between ERBS and OS in post-stabilization years is minimal (3 vs. 2½ months in Sample 1; 3½ vs. 3 months in Sample 2). The similarity in levels in post-stabilization years reflects two opposite trends: in ERBS reserves fall in the stabilization year and, although they recover somewhat in the following years, they do not reach their pre-stabilization peak. In OS, on the other hand, there is a general upward trend in reserves around stabilization; this increase occurs in years $t+1$ and $t+2$ in Sample 1 and between years $t-1$ and $t+1$ in Sample 2. The different trends are unequivocal in year $t$, when inflation first comes down: reserves are falling under ERBS but going up under OS, although these changes are not statistically significant. A possible interpretation of the fact that reserves tend to increase in OS in post-stabilization years is that they really are not
Figure 8. The Real Exchange Rate During Disinflation
(Value in year \( t = 100 \))

Sources: IFS, national sources, and author's estimates.
Figure 9. International Reserves During Disinflation

(In months of imports)

ERBS (Sample 1): Gross international reserves

OS (Sample 1): Gross international reserves

ERBS (Sample 2): Gross international reserves

OS (Sample 2): Gross international reserves

Sources: IFS, national sources, and author's estimates.
pure MBS. Rather, these programs may involve some form of intervention in the foreign exchange market in order to facilitate the remonetization of the economy.\textsuperscript{17}

**Success or Failure of ERBS**

The ERBS literature often mentions a relatively high rate of failure among ERBS, but no formal claim has been made about a systematic tendency for one type of stabilization program to succeed or fail more frequently than the other. One could argue, however, that ERBS is an intrinsically riskier disinflation strategy because, by targeting the exchange rate, policymakers provide speculators with the opportunity of a one-sided bet, and thus, these programs can potentially fail even in cases where failure is not warranted by macroeconomic fundamentals. On the other hand, as has been discussed earlier, it has been argued that committing to a fixed exchange rate raises the game’s stakes and, therefore, that it is more likely to impose financial discipline, ultimately raising the probability of success. Looking at the rates of success of both ERBS and OS in the stabilization programs studied in Sample 2 can shed some light on the empirical relevance of these issues.

There is no obvious, clear-cut definition of success that can be used here, especially considering that, by following a rule that defines a stabilization episode as one that produced an actual decline in inflation that lasted for at least two years, one is already biasing the sample somewhat in the direction of success, however defined. Success would then have to be related to a program’s ability to keep inflation low for some time beyond the two-year horizon. In principle, it is tempting to require a relatively large number of years of stability to consider a program truly successful. However, there is a risk associated with using too large a number. If a program brings inflation down and keeps it down for, say, five years but then inflation spirals out of control beginning in year six, was the original program ultimately unsuccessful? Or could the new inflationary episode be the creation of a different economic team working in a different policy environment? Or could the economy have been hit by an extraordinarily adverse shock? It seems that the longer the number of years of low inflation required to consider a stabilization successful, the higher the risk that some truly successful program may be recorded as a failure.

Success was defined on the basis of inflation performance on the second and third post-stabilization years ($t+2$ and $t+3$). An obvious advantage of limiting the horizon to $t+3$ is that a verdict (successful or not) could be reached for all 51 programs in Sample 2. Several rules were tried, of which two were selected, essentially because they did not produce extreme rates of success or failure:

- Success—Criterion (1): during the second and third post-stabilization years, inflation remains at or below whatever level inflation reached during the stabilization year.

\textsuperscript{17}This would explain why OS are not found to be recessionary, as would be expected in the case of pure MBS. I am indebted to Martin Uribe for this point. His 1999 paper (see the Reference section) provides a detailed comparison of pure MBS vs. those that allow for an initial remonetization of the economy.
Javier Hamann

- Success—Criterion (2): during the second and third post-stabilization years, inflation remains at or below three-quarters of the inflation rate prevailing the year before stabilization.\(^{18}\)

The results are reported in Table 3. According to Criterion (1), which is more restrictive, 20 of the 51 programs were successful. Among ERBS, 5 out of the 13 programs were successful, which implies the same rate of success for ERBS (38 percent) as for OS (39 percent). If Criterion (2) is used, 34 out of the 51 programs can be considered successful. Interestingly, of the 13 ERBS episodes 9 are now considered successful, which, again, implies a similar rate of success for ERBS (69 percent) as for OS (66 percent). There is no evidence, therefore, to support the view that programs associated with one or the other anchor are generally more successful.

III. Summary and Conclusions

This paper explores whether the distinctive features of ERBS identified in the literature for a group of Latin American countries and Israel also appear in a larger and somewhat different sample. In the construction of this sample, stabilization episodes are identified and timed by applying a simple rule to a data set of annual inflation rates for the period 1960–97 for a group of 143 countries. Additional evidence supporting the notion that the sample indeed contains stabilization episodes, as opposed to simply positive supply shocks, is provided. In order to gauge the robustness of the results, an alternative sample constructed by Easterly (1996) is also used.

The results are not totally supportive of the ERBS syndrome described in the literature. There is no evidence of a “recession now vs. recession later” trade-off between ERBS and OS; in fact, growth performance during stabilization is good under both anchors, as had been found by Easterly (1996). There appears to be a distinctive consumption boom during ERBS, but not an investment boom; investment seems to recover more sluggishly after ERBS than in other stabilization programs. The real exchange rate does appreciate following ERBS and depreciate in other cases, but these movements are not statistically significant. The current account does not exhibit a clear trend in post-stabilization years. There is also no evidence that fiscal discipline is enhanced by the adoption of an exchange rate anchor, or that there are any systematic differences in the records of success of ERBS and OS.

The results of this paper seem to warrant formal testing of various hypotheses related to the effects of inflation stabilization. For example, the fact that in several instances there are substantial differences between ERBS and OS not only in post-stabilization but also in pre-stabilization years may suggest that the selection of a nominal anchor is in itself an endogenous phenomenon—as has already been suggested elsewhere. This would shed some light on the potential role of initial conditions as determinants of post-stabilization dynamics. The effect on growth

\(^{18}\)The reader will recall that the selection rule underlying Sample 2 requires a reduction of the inflation rate of at least one-quarter.
Table 3. Sample 2: Successful Stabilization Episodes

<table>
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<tr>
<th>Country</th>
<th>Stabilization Date</th>
<th>Exchange Rate Anchor</th>
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<th>Successful Criterion 2</th>
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<td>Yes</td>
<td>Yes</td>
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</table>
performance during disinflation of the pre-existing level of inflation, or of the duration of high inflation, also deserves attention. And, of course, several of the elements of the ERBS syndrome need to be reexamined in a context that explicitly accounts for other phenomena and uses a larger control group than the one that has been typically used.

Finally, the data do not provide strong indications that the rules used for selecting a sample of stabilization episodes has systematically timed stabilization episodes incorrectly. There is only weak evidence supporting the view that inflation stabilization is found to be expansionary just because the “dirty work” of macroeconomic correction, in the form of correction of external imbalances, may have preceded inflation stabilization by a year or two. Further work with higher frequency data is needed, however, to deepen our understanding of the dynamics of disinflation under different nominal anchors.\(^{19}\)

**APPENDIX I**

**Sources of Data**

The IMF’s *International Financial Statistics* (IFS) was the main source of data for all variables, except for the current account and the real exchange rate. Current account data from the IMF’s *World Economic Outlook* (WEO) database was used, except for one case (Brazil 1963–69) where, due to the lack of data on the current account, trade balance data from IFS had to be

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\(^{19}\)An (admittedly crude) attempt at comparing the dynamics of interest rates between ERBS and OS was made, using monthly data for the stabilization year. This exercise revealed no clear differences in the behavior of real interest rates across stabilization strategies: real (deposit or T-bill) interest rates exhibited no trend during the year; were somewhat more volatile in the case of OS; and averaged about 4 percent in ERBS vs. 0.25 percent in OS, but this difference was not statistically significant.
used. In several instances, data from national sources were needed to fill some gaps (especially in the oldest episodes), or when IFS data contained breaks (typically in the case of the population variable, which was needed to compute GDP per capita). The fiscal data refers to the central government. For the real exchange rate, a multilateral real effective exchange rate variable was available from an IMF internal database from 1980 onwards. For countries for which this variable was not available, or in cases where data prior to 1980 was needed, a bilateral real exchange rate vis-à-vis the U.S. dollar was constructed.

REFERENCES


Javier Hamann


Income Inequality: Does Inflation Matter?

ALEŠ BULÍŘ

This paper contributes to the income inequality literature that is based on the traditional Kuznets model. Level of development, state employment, fiscal redistribution, and price stability are found to improve income inequality in a given country. The positive impact of price stability on income distribution is nonlinear. The reduction in inflation from hyperinflationary levels significantly lowers income inequality, while further reduction toward a very low level of inflation seems to bring about negligible additional gains in the Gini coefficient. [JEL D31, O15, E31, C21]

The distribution of income in a country is traditionally assumed to shift from relative equality to inequality and back to greater equality as the country develops. Intuitively, inequality will rise as some people move away from prevailing traditional activities, which yield a low marginal product, into more productive ventures. At some point, the marginal product of all economic activities converges and income differences narrow. Based on this reasoning, the so-called Kuznets hypothesis (Kuznets, 1955) postulates a nonlinear relationship between a measure of income distribution and the level of economic development. Income distribution is also a concern for policy makers: government policies can, by design, change income distribution to some degree through taxes, transfers, public sector employment, and other policy instruments.

*Ales Bulir is currently an Economist in the Policy Development and Review Department of the IMF. The work on this paper was started when the author was with the IMF’s Monetary and Exchange Affairs Department. Branko Milanovic kindly shared his original database with the author. During the process of writing, many helpful comments were provided by William E. Alexander, Eliana Cardoso, David T. Coe, Charles Enoch, John Green, Anne-Marie Guido, Ernesto Hernandez-Catá, Lamin Leigh, Branko Milanovic, Anthony J. Pellechio, Thomas Walter, and Holger Wolf. The author, however, remains responsible for any errors. Kiran Sastry provided excellent research assistance.
Empirical multicountry studies of income distribution have documented significant residuals in Kuznets-type models even after corrections have been made for explicit redistribution policies, employment by the state, regional development, the age profile of the population, and other factors. The presence of country-specific contributions to income inequality, or "fixed effects," can account for 50 percent or more of the variation in the income distribution measure.

It is surprising that inflation, as opposed to the above-mentioned variables, has been largely omitted in cross-country empirical research. Besides Bulir and Gulde (1995), the only exceptions are papers by Adelman and Fuwa (1992) and Sarel (1997). By way of comparison, time-series models, following the pioneering work by Schultz (1969) and Blinder and Esaki (1978), have found inflation to contribute to cyclical changes in income distribution in 12 developed and emerging economies. A link between inflation and income distribution was also established by microeconometric studies employing U.S. household data (see Minarik (1979)).

Why has inflation been omitted in most cross-country studies of income distribution? As noted by previous researchers, no comprehensive alternative to the simple Kuznets hypothesis has been suggested. So far, most authors have either estimated the simple Kuznets hypothesis or resorted to ad hoc augmentation of the original model. The latter approach is exemplified by Milanovic (1994, p. 3), who argues that "income distribution is determined (1) by factors that are in the short run, from the point of view of policy makers or society as a whole, 'given,' and (2) by social (or public policy) choice." While the former set of factors comprises income per capita and the regional heterogeneity of a country, the latter includes the percentage of workers employed in the state sector and government transfers as a percent of GDP.

Following Milanovic, and using his original data, this paper augments the Kuznets hypothesis of income inequality by incorporating inflation. Using a cross-country database containing 75 countries (Table 1), it is found that past inflation affects current levels of income inequality as measured by Gini coefficients, and that these results are robust even after controlling for redistributive policies. The positive impact of price stability on income distribution is nonlinear—the reduction in inflation from hyperinflation levels significantly lowers income inequality, while further reduction toward a very low level of inflation seems to bring about negligible gains in the Gini coefficient.

When inflation is included, the results seem to contradict the traditional critique that the Kuznets model depends on the inclusion of Latin American...
### Table 1. Factors Affecting Income Distribution

<table>
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<th>Country</th>
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<th>GDP per Capita</th>
<th>Social Transfers</th>
<th>State Employment</th>
<th>Inflation</th>
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<td>567</td>
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<td>3.1</td>
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<td>11.7</td>
<td>514.2</td>
</tr>
<tr>
<td>Chile</td>
<td>1987</td>
<td>48.2</td>
<td>4,719</td>
<td>19.1</td>
<td>9.2</td>
<td>23.4</td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>1989</td>
<td>37.9</td>
<td>4,857</td>
<td>13.1</td>
<td>78.9</td>
<td>343.4</td>
</tr>
<tr>
<td>South Africa</td>
<td>1980</td>
<td>57.0</td>
<td>4,936</td>
<td>8.9</td>
<td>13.2</td>
<td>11.9</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1989</td>
<td>48.4</td>
<td>5,070</td>
<td>8.0</td>
<td>8.4</td>
<td>1.3</td>
</tr>
<tr>
<td>Mexico</td>
<td>1984</td>
<td>50.6</td>
<td>5,323</td>
<td>5.6</td>
<td>21.4</td>
<td>56.1</td>
</tr>
<tr>
<td>Venezuela</td>
<td>1989</td>
<td>44.1</td>
<td>5,648</td>
<td>5.6</td>
<td>19.3</td>
<td>33.0</td>
</tr>
<tr>
<td>South Korea</td>
<td>1982</td>
<td>35.7</td>
<td>5,682</td>
<td>2.9</td>
<td>9.3</td>
<td>18.0</td>
</tr>
<tr>
<td>Uruguay</td>
<td>1989</td>
<td>42.4</td>
<td>5,787</td>
<td>10.5</td>
<td>21.4</td>
<td>71.0</td>
</tr>
<tr>
<td>Hungary</td>
<td>1989</td>
<td>23.1</td>
<td>5,924</td>
<td>19.9</td>
<td>93.9</td>
<td>10.7</td>
</tr>
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</table>
Table 1. (concluded)

<table>
<thead>
<tr>
<th>Country</th>
<th>Year of Gini Coefficient</th>
<th>Year of Gini Observation</th>
<th>GDP per Capita</th>
<th>Social Transfers</th>
<th>State Employment</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portugal</td>
<td>38.1</td>
<td>1974</td>
<td>5,984</td>
<td>17.1</td>
<td>14.2</td>
<td>11.9</td>
</tr>
<tr>
<td>Greece</td>
<td>39.9</td>
<td>1986</td>
<td>6,436</td>
<td>16.7</td>
<td>10.7</td>
<td>20.4</td>
</tr>
<tr>
<td>Ireland</td>
<td>34.6</td>
<td>1987</td>
<td>7,022</td>
<td>25.1</td>
<td>19.6</td>
<td>6.3</td>
</tr>
<tr>
<td>Czechoslovakia</td>
<td>19.5</td>
<td>1988</td>
<td>7,421</td>
<td>21.3</td>
<td>98.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Spain</td>
<td>31.5</td>
<td>1988</td>
<td>8,253</td>
<td>18.1</td>
<td>13.7</td>
<td>7.8</td>
</tr>
<tr>
<td>Cyprus</td>
<td>35.7</td>
<td>1988</td>
<td>8,434</td>
<td>8.8</td>
<td>12.2</td>
<td>6.6</td>
</tr>
<tr>
<td>Singapore</td>
<td>41.0</td>
<td>1988</td>
<td>10,417</td>
<td>18.3</td>
<td>10.4</td>
<td>0.7</td>
</tr>
<tr>
<td>Israel</td>
<td>33.3</td>
<td>1979</td>
<td>10,864</td>
<td>22.1</td>
<td>27.1</td>
<td>46.8</td>
</tr>
<tr>
<td>Bahamas</td>
<td>42.8</td>
<td>1989</td>
<td>11,004</td>
<td>1.2</td>
<td>18.6</td>
<td>5.1</td>
</tr>
<tr>
<td>New Zealand</td>
<td>30.0</td>
<td>1986</td>
<td>11,308</td>
<td>19.6</td>
<td>24.7</td>
<td>11.7</td>
</tr>
<tr>
<td>Austria</td>
<td>24.9</td>
<td>1989</td>
<td>12,353</td>
<td>27.9</td>
<td>37.9</td>
<td>2.2</td>
</tr>
<tr>
<td>Netherlands</td>
<td>32.1</td>
<td>1983</td>
<td>12,684</td>
<td>31.1</td>
<td>15.0</td>
<td>5.2</td>
</tr>
<tr>
<td>Italy</td>
<td>31.3</td>
<td>1990</td>
<td>13,001</td>
<td>24.4</td>
<td>20.9</td>
<td>5.7</td>
</tr>
<tr>
<td>Belgium</td>
<td>27.4</td>
<td>1983</td>
<td>13,005</td>
<td>30.3</td>
<td>22.5</td>
<td>7.0</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>28.1</td>
<td>1979</td>
<td>13,060</td>
<td>19.8</td>
<td>22.8</td>
<td>15.7</td>
</tr>
<tr>
<td>France</td>
<td>30.7</td>
<td>1981</td>
<td>13,584</td>
<td>31.0</td>
<td>21.2</td>
<td>11.2</td>
</tr>
<tr>
<td>Denmark</td>
<td>28.0</td>
<td>1989</td>
<td>13,607</td>
<td>33.3</td>
<td>29.4</td>
<td>4.3</td>
</tr>
<tr>
<td>Japan</td>
<td>35.0</td>
<td>1985</td>
<td>13,645</td>
<td>17.5</td>
<td>9.5</td>
<td>2.8</td>
</tr>
<tr>
<td>Norway</td>
<td>26.9</td>
<td>1979</td>
<td>13,819</td>
<td>27.1</td>
<td>24.8</td>
<td>8.6</td>
</tr>
<tr>
<td>Finland</td>
<td>20.2</td>
<td>1985</td>
<td>13,980</td>
<td>22.0</td>
<td>28.7</td>
<td>8.6</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>48.5</td>
<td>1981</td>
<td>14,014</td>
<td>2.9</td>
<td>7.9</td>
<td>10.3</td>
</tr>
<tr>
<td>Australia</td>
<td>31.6</td>
<td>1982</td>
<td>14,529</td>
<td>17.1</td>
<td>29.3</td>
<td>9.6</td>
</tr>
<tr>
<td>Germany</td>
<td>27.8</td>
<td>1981</td>
<td>14,621</td>
<td>25.7</td>
<td>22.3</td>
<td>4.4</td>
</tr>
<tr>
<td>Sweden</td>
<td>22.9</td>
<td>1981</td>
<td>14,941</td>
<td>32.2</td>
<td>36.2</td>
<td>10.9</td>
</tr>
<tr>
<td>Canada</td>
<td>32.0</td>
<td>1981</td>
<td>17,681</td>
<td>21.5</td>
<td>24.1</td>
<td>9.7</td>
</tr>
<tr>
<td>Switzerland</td>
<td>35.5</td>
<td>1982</td>
<td>17,763</td>
<td>14.9</td>
<td>10.4</td>
<td>4.2</td>
</tr>
<tr>
<td>United States</td>
<td>34.4</td>
<td>1979</td>
<td>19,851</td>
<td>17.7</td>
<td>15.8</td>
<td>8.1</td>
</tr>
<tr>
<td>Full sample average</td>
<td>41.7</td>
<td>1979</td>
<td>6,317</td>
<td>11.8</td>
<td>20.5</td>
<td>69.6</td>
</tr>
<tr>
<td>Excluding hyperinflationary countries</td>
<td>41.2</td>
<td>6,456</td>
<td>12.0</td>
<td>19.9</td>
<td>15.3</td>
<td></td>
</tr>
</tbody>
</table>


1Ranked in ascending order by GDP per capita.
2In 1988 U.S. dollars; the same year as the observation of the Gini coefficient.
3In percent of GDP; the same year as the observation of the Gini coefficient.
4In percent of total labor force; the same year as the observation of the Gini coefficient.
5Five-year average preceding the year of the Gini coefficient.

Specifically, inclusion of a dummy for Latin America (or for any other region) does not lead to a breakdown of the Kuznets hypothesis, as in Deininger and Squire (1996b). This result suggests that inflation might be one of the factors affecting inequality.
INCOME INEQUALITY: DOES INFLATION MATTER?

"missing" variables in Kuznets-type models. It is not a coincidence that high-inequality countries, such as many in South America, have generally suffered from high inflation or hyperinflation, and that low-inequality Asian countries have had lower-than-average inflation rates.

I. Inflation as a Factor Affecting Income Distribution

Economic theory has identified various costs of inflation, as well as actions that can be taken to avoid those costs. For example, optimizing holdings of domestic currency can prevent losses associated with expected inflation. Similarly, investing in inflation-indexed bonds or negotiating inflation-adjusted employment contracts helps protect against unexpected inflation. Protecting against inflation uncertainty may be difficult, however, or the transaction cost of doing so may be too high.

For the sake of simplicity, assume that the economy is inhabited by two types of workers: "outsiders," who accept nominal contracts; and "insiders," who accept inflation-adjusted wage contracts. Let us start with an outsider. She receives a wage, which is a product of her wage rate and hours worked, and also holds and trades in a non-interest-bearing asset, that is, currency. If inflation is positive, the value of this asset declines. The worker has to allocate her wage and nonwage income between current consumption and the holdings of the nominal asset.

How does inflation affect the outsider’s behavior? First, the amount of labor supplied by the worker is affected by the change in the price level—inflation shifts the labor supply schedule inward, lowering the amount of hours worked and, eventually, total earnings. (This outcome assumes, of course, a horizontal labor demand schedule and an upward-sloping labor supply schedule in the usual labor-wage space.) The outsider responds to losses associated with the so-called shoe leather cost—the cost of being locked into nominal contracts—and the cost of protracted wage negotiations. In each of these cases, both expected and unexpected inflation “distracts” the outsider from working and forces her to engage in time-consuming activities to minimize her inflation-induced income losses (see Braun (1994), Fischer (1993), and King and Wolman (1996)).

There is also a second type of cost, affecting outsiders: inflation reduces the value of a nominal asset they hold. Irrespective of time spent by the worker, the losses stemming from negative real returns can be avoided only if inflation is fully anticipated and if the holding of currency can drop to zero. The latter is clearly an unsustainable assumption in a cash-in-advance economy.

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4Naturally, this paper will not consider all costs discussed in the literature. See Drifflit, Mizon, and Ulph (1990) for a review.
5A formal derivation of the model is contained in the Appendix.
6King and Wolman (1996) estimate that annual inflation of 12 percent would result in a loss of six more hours per quarter than would inflation of 5 percent. By way of comparison, price stability would result in a gain of seven hours per quarter.
7Quadrini and Rios-Rull (1997) discuss a similar issue (earning uncertainty) in the context of the dynastic model of income and wealth distribution.
Inflation reduces outsiders’ available resources for consumption both through limiting the amount of hours worked and through a loss in asset principal. A more interesting question, however, is, what does this framework say about relative incomes of workers whose earnings have different inflation sensitivity? To answer this question, we will introduce an “insider” worker.

Let us assume that another worker (the insider) holds assets other than currency and is employed under a different wage regime than the outsider. For example, she might receive most of her compensation in stock options or inflation-adjusted nonwage benefits, the market value of which is uncorrelated with inflation. Alternatively, she might be employed in a unionized sector with indexed wages (through a cost of living adjustment or similar mechanism). Therefore, she faces little or no inflation distraction, and her marginal product of labor is unchanged. It is reasonable to assume that these compensation characteristics exclude wage earners at the bottom of the income scale, who are generally much less protected from cyclical real-wage fluctuations.8

Returns on assets owned by a wealthy insider might also be better protected from inflation. She might buy assets, returns on which (i) are uncorrelated or weakly correlated with inflation or (ii) grow faster than inflation. The conditions that must hold if temporary financial investments of periodic income are to be advantageous are quite severe and might exclude low-income households from those activities.9 The severity of those conditions declines with the level of development of financial markets in the country.

The effects of inflation can be summarized as follows. First, workers whose earnings are protected against price level changes (insiders) would increase their incomes relative to the first, unprotected group (outsiders), and the pretransfer income distribution would widen. Second, in absolute terms, incomes of both groups would fall.10 Third, while government policies can prevent outsiders from falling into poverty by, say, taxing the rich and making transfers to the poor, those policies are likely to be insufficient to narrow the inflation-generated income distribution gap, as the number of transfer-receiving outsiders is typically larger than the number of taxed insiders. Therefore, one would expect the effects of fiscal equalization measures to be weakly correlated, if at all, with inflation-generated changes in income inequality.

II. Cross-Country Empirical Evidence

In this section, we will test the hypothesis that a part of the variation in income distribution among countries can be explained by previous inflation in those countries.

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8Between 1981 and 1996, for example, the U.S. federal minimum wage was raised only once, and its value in 1996 dollars declined from about US$6 per hour in 1981 to the 1996 level of US$4.25 per hour.
9For example, Goodhart (1989) shows that, with an annual interest rate of 6 percent and fixed cost per transaction of US$2, it would require a monthly salary of about US$1,600 in order for it to be economical for the agent to purchase and resell any temporary assets.
10In the short term, the indexation scheme can overcompensate insiders for inflation, as shown by Brandolini and Sestito (1994) on the example of Italy’s scala mobile. It can be argued, however, that this policy is not sustainable because it would lead to changes in the labor-capital ratio.
The Data and the Original Milanovic Results

The original sample, which was compiled by Milanovic (1994), consists of 80 countries ranked by GDP per capita in ascending order; it was used to test his so-called Augmented Kuznets Hypothesis. Gini observations (one per country) range over a period of 22 years (1970–91), a result of the scarcity of consistent Gini observations. Moreover, these observations had to be paired with almost equally scarce state employment and transfers data.¹¹ We have narrowed the Milanovic sample to 75 countries for which we could collect the appropriate inflation data from International Financial Statistics (IFS) see Table 1. Countries are ranked by their GDP per capita in ascending order: the poorest country is Tanzania (US$567 in 1988 dollars), the richest is the United States (US$19,850 in 1988 dollars).

Milanovic tested the hypothesis according to which government policies can significantly change income distribution: “inequality in richer societies does not decrease because of economic factors, but because societies choose less inequality” (p. 33). His preferred variables, the so-called social choice factors, included the percentage of all employed who work in the state sector (inclusive of government administration), the percentage share of cash and in-kind social transfers in the country’s GDP, and a dummy for Asian countries.

While the Kuznets hypothesis held in Milanovic’s results, the effect of social choice variables was substantial and rose with the level of income per capita. For example, state employment and transfers lowered the Gini coefficient three times more on average in countries with GDP per capita between US$6,000 and US$10,000 than in countries with GDP per capita below US$1,500 (see Table 5 in Milanovic (1994)). On average, social choice variables reduced the Gini coefficient from 54 Gini points to 41 Gini points, that is, by one-fourth.

New Hypotheses

While Milanovic was mainly concerned with fiscal and quasi-fiscal channels of redistribution, either through explicit transfers or through broadly defined state sector employment, we add inflation to the list of explanatory variables. We expect the impact of inflation on income distribution to be stronger at higher inflation rates. In principle, the impact of inflation should be independent of the level of development and of the level of fiscal redistribution.

Our sample and regression estimates differ in two ways from the original Milanovic results. First, inflation data are not available for 5 out of the 80 countries in his sample. Restricting the number of observations to 75, however, changes neither the level of statistical significance nor the size of the regression coeffi-

¹¹Hypothetically, this lack of data might create interpretation problems. For example, did the first oil shock affect the countries’ income distribution? Are there secular cycles in income distribution across countries? Even though very little is known about the impact of these shocks on income distribution, time per se has no effect in our regressions: all experiments with various time dummies yielded statistically insignificant results. One can speculate that these shocks are correlated with variables already contained in the regressions, most notably with income, inflation, and transfers.
ciences as compared with Milanovic's results. Coefficients of determination and standard errors of regression are only marginally worse. Second, owing to multicollinearity, we exclude two explanatory variables from Milanovic's preferred equation: the ratio of average incomes between the richest and the poorest region within a country, and a dummy for Asian countries. This exclusion—like the change in the number of observations—changes neither the significance of individual parameters of the remaining variables nor the overall results. A correlation matrix of variables employed in our regressions is presented in Table 2.

There is little reason to assume that changes in inflation can cause a major swing in a country's income distribution rapidly. If this were so, we would observe much larger annual swings in income distribution because inflation is prone to cyclical fluctuations. More likely, the full effects of inflation take time to feed through the system. Thus, one should look at cumulative or average changes preceding the period of observation of the income inequality indicator. Interestingly, a country ranking by average inflation changes little whether three-, five-, or seven-year averages are used. Hence, we use a five-year average for inflation based on goodness-of-fit criteria.

The regression equation, with the Gini coefficient as the dependent variable, includes a constant, a quadratic expression for GDP per capita to capture the nonlinearity of the Kuznets hypothesis, state employment, transfers as a percentage of GDP, and either three or four measures of inflation. Income inequality is assumed to initially rise with development (as proxied by GDP per capita) but to decline in higher stages of development; therefore, the expected signs of $Y$ and $Y^2$ are positive and negative, respectively. State employment and fiscal transfers are expected to lower inequality and have negative expected signs. Finally, high inflation should unambiguously increase inequality vis-à-vis low inflation.

The literature suggests that most macroeconomic effects of inflation are nonlinear. Therefore, adding average inflation rates to the Kuznets model yields statistically insignificant results even when various nonlinear transformations of inflation are used, similarly to results in Sarel (1997). To correct for nonlinearity, we distinguish several levels of inflation. First, we divide the inflation sample into three groups: hyperinflation (more than 300 percent annually for four countries, with a mean of 1,034 percent), high inflation (between 300 percent and 41 percent annually for seven countries, mean of 56 percent), and low inflation (A) (less than 40 percent annually for 64 countries, mean of 9 percent). Second, we split the last group of countries (the so-called low inflation (A)) into those with inflation between 40 percent and 5 percent annually (called low inflation (B), 47 countries, mean of 14 percent), and those below 5 percent (called very low inflation, 17 countries, mean of 3 percent).

12 Nevertheless, several countries have pronounced procyclical or countercyclical patterns of inequality. Procyclical patterns of inequality have been observed in Brazil (Cardoso, 1993) and Greece (Livada, 1992), while countercyclical patterns have been observed in Italy (Brandolini and Sestito, 1994) and the United States (Blinder and Esaki, 1978).

13 See Milanovic (1994) for discussion of a possible confusion in determining the signs.

Table 2. Estimated Correlation Matrix of Variables

<table>
<thead>
<tr>
<th></th>
<th>Gini</th>
<th>GDP</th>
<th>State Employment Transfers</th>
<th>Hyper-inflation</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>-0.63</td>
<td>0.28</td>
<td></td>
<td>-0.05</td>
<td>0.12</td>
<td>-0.09</td>
</tr>
<tr>
<td>State employment</td>
<td>-0.57</td>
<td>0.74</td>
<td>0.38</td>
<td>-0.73</td>
<td>-0.05</td>
<td>-0.02</td>
</tr>
<tr>
<td>Transfers</td>
<td>-0.05</td>
<td>0.05</td>
<td>0.27</td>
<td>-0.02</td>
<td>-0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Hyperinflation</td>
<td>0.18</td>
<td>-0.05</td>
<td>0.12</td>
<td>-0.09</td>
<td>-0.07</td>
<td>-0.07</td>
</tr>
<tr>
<td>High inflation</td>
<td>0.28</td>
<td>0.74</td>
<td>0.38</td>
<td>-0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Low inflation</td>
<td>0.02</td>
<td>-0.11</td>
<td>-0.22</td>
<td>-0.08</td>
<td>-0.31</td>
<td>-0.42</td>
</tr>
<tr>
<td>Very low inflation</td>
<td>0.04</td>
<td>0.13</td>
<td>0.00</td>
<td>0.17</td>
<td>-0.13</td>
<td>-0.17</td>
</tr>
</tbody>
</table>

Source: Calculations based on Table 1.

1Gini coefficient of disposable income (for Organization for Economic Cooperation and Development members and socialist economies) and Gini coefficient of gross income for African, Asian, and Latin American countries. The year of the Gini coefficient observation for each country is the same as that of the other variables.

2The country’s GDP per capita in thousands of 1988 U.S. dollars.

3The percentage share of workers in the state sector (including government administration) in total employment.

4The percentage share of cash and in-kind social transfers in the country’s GDP.

5Dummy variable: 1 if five-year average annual inflation more than 300 percent; zero otherwise.

6Dummy variable: 1 if five-year average annual inflation more than 40 percent but less than 300 percent; zero otherwise.

7Dummy variable: 1 if five-year average annual inflation more than 5 percent but less than 40 percent; zero otherwise.

8Dummy variable: 1 if five-year average annual inflation less than 5 percent; zero otherwise.

While the 40 percent breakpoint is taken from Bruno (1995) and hyperinflationary countries are distinguished mechanically, the breakpoint between low and very low inflation is chosen heuristically. Although we have experimented with several breakpoints for very low inflation (from 2 percent to 7 percent), none of them is clearly superior to the 5 percent breakpoint. Consequently, the Kuznets equation is estimated for both three and four inflation steady states, with the former omitting the distinction between low and very low inflation. In addition, the equation is also estimated without the four hyperinflation countries, narrowing the sample to 71 observations.

We select intercept dummies as the best transformation of the inflation variable. In principle, one can regress Gini coefficients either on intercept dummies (the inflation variable is 1 if the actual average is within its specified bounds and zero otherwise) or on slope dummies (actual inflation multiplied by its dummy value). While the first approach presents an average impact of a particular level of inflation on income distribution, the second approach shows how much income distribution changes owing to a 1 percent change in inflation. Slope dummies have lower estimates of residual sums of squares and higher $R^2$, however, because of

15It was successfully tested against 30 percent and 50 percent breakpoints.
higher multicollinearity, usually one or more parameter estimates are statistically insignificant or the overall improvement in fit is marginal. Including both dummies leads to statistically insignificant estimates.

Overview of Results

The empirical results, summarized in Tables 3 and 4, are divided into two parts: the estimated parameters of the Augmented Kuznets Hypothesis as proposed by Milanovic and the estimated parameters of the newly added inflation variables. The inclusion of the new explanatory variables only marginally affects the estimated parameters of the Augmented Kuznets Hypothesis, and most of the regressions’ variation vis-à-vis the new variables is captured by changes in the statistically insignificant intercept. As in the Milanovic regressions, the inverted U-shaped income distribution profile seems to hold.

The results lend additional support to the Kuznets hypothesis because some of the previously unexplained regional differences can be attributed to past inflation developments. For example, the high inequality in middle-income Latin American countries (with an average Gini coefficient of 50.6 compared with the sample average of 41.7) can be viewed as a consequence of the comparatively high inflation rates. Excluding countries in hyperinflation, the five-year Latin American inflation rate is 27 percent, compared with the sample average of 14 percent. By way of comparison, the low inequality in middle-income Asian countries (with an average Gini coefficient of 42.1) can be rationalized by the low inflation rates (10 percent).

Taking into account persistent heteroscedasticity, we reestimate the standard errors using the White heteroscedastic-consistent standard errors procedure. No spatial autocorrelation was observed and, therefore, we do not report the results of autocorrelation tests. On the one hand, the overall fit is quite robust in the sense that dropping or adding variables or shortening the sample affects parameter estimates only marginally. On the other hand, as can be seen in Tables 3 and 4, some of the newly included variables are not always statistically different from zero at the 5 percent significance level. This is an unfortunate but inescapable effect of multicollinearity of variables: the standard errors of parameters rise when mutually correlated explanatory variables are added to the regression (for example, state employment and low inflation).

We also address the possibility that some variables may be determined endogenously. For example, it is well known that transfers tend to be higher in more developed countries: indeed, the correlation coefficient in our sample is 0.73. Hence, in Tables 3 and 4 we display along with OLS regressions also instrumental variable (IV) regressions, where transfers are instrumented by their

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16The null hypothesis of heteroscedasticity of residuals cannot be rejected at the 1 percent significance level for all estimates.

17This is especially true for the two-tail t-test (the 1 percent and 5 percent critical values are 2.63 and 1.99, respectively). However, no parameter estimate would have missed the 5 percent threshold had we applied the one-tail test (the 1 percent and 5 percent critical values are 2.38 and 1.67, respectively). The one-tail test would be adequate here, since we know the expected sign of each parameter.
### Table 3. The Augmented Kuznets Hypothesis: Adding Inflation
(Ordinary least squares (OLS) and instrumental variable technique (IV), heteroscedastic-consistent standard errors)

<table>
<thead>
<tr>
<th>Eq</th>
<th>Constant</th>
<th>( Y )</th>
<th>( Y^2 )</th>
<th>State</th>
<th>Employment</th>
<th>Transfers</th>
<th>Hyper-inflation</th>
<th>High Inflation</th>
<th>Low Inflation(A)</th>
<th>No. of obs.</th>
<th>Adj. ( R^2 )</th>
<th>Heteroscedasticity</th>
<th>Normality</th>
<th>RSS</th>
<th>LM Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>OLS</td>
<td>-97.08</td>
<td>39.800</td>
<td>-2.608</td>
<td>-0.223</td>
<td>-0.416</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.710</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>...</td>
</tr>
<tr>
<td></td>
<td>(0.21)</td>
<td>(0.04)</td>
<td>(0.00)</td>
<td>(0.00)</td>
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<td>(0.00)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>OLS</td>
<td>-111.58</td>
<td>43.326</td>
<td>-2.814</td>
<td>-0.230</td>
<td>-0.421</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.674</td>
<td>11.82</td>
<td>0.274</td>
<td>2912</td>
<td>...</td>
</tr>
<tr>
<td></td>
<td>(1.42)</td>
<td>(2.30)</td>
<td>(2.53)</td>
<td>(8.21)</td>
<td>(3.96)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2</td>
<td>IV</td>
<td>-120.89</td>
<td>45.929</td>
<td>-3.000</td>
<td>-0.238</td>
<td>-0.350</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.672</td>
<td>11.80</td>
<td>0.106</td>
<td>2924</td>
<td>...</td>
</tr>
<tr>
<td></td>
<td>(1.48)</td>
<td>(2.33)</td>
<td>(2.53)</td>
<td>(8.13)</td>
<td>(2.02)</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>OLS</td>
<td>-96.30</td>
<td>39.455</td>
<td>-2.579</td>
<td>-0.242</td>
<td>-0.397</td>
<td>7.815</td>
<td></td>
<td></td>
<td>75</td>
<td>0.694</td>
<td>12.52</td>
<td>0.529</td>
<td>2692</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>(1.23)</td>
<td>(2.10)</td>
<td>(2.32)</td>
<td>(11.09)</td>
<td>(3.78)</td>
<td>(2.66)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>IV</td>
<td>-102.15</td>
<td>41.096</td>
<td>-2.697</td>
<td>-0.247</td>
<td>-0.351</td>
<td>7.902</td>
<td></td>
<td></td>
<td>75</td>
<td>0.693</td>
<td>13.18</td>
<td>0.036</td>
<td>2697</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>(1.26)</td>
<td>(2.10)</td>
<td>(2.29)</td>
<td>(10.34)</td>
<td>(2.01)</td>
<td>(2.65)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>OLS</td>
<td>-82.463</td>
<td>38.062</td>
<td>-2.497</td>
<td>-0.249</td>
<td>-0.388</td>
<td>-6.673</td>
<td>-8.105</td>
<td></td>
<td>75</td>
<td>0.691</td>
<td>11.99</td>
<td>0.463</td>
<td>2682</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>(1.02)</td>
<td>(1.97)</td>
<td>(2.18)</td>
<td>(10.87)</td>
<td>(3.64)</td>
<td>(2.08)</td>
<td>(2.67)</td>
<td></td>
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<tr>
<td>3</td>
<td>IV</td>
<td>-87.29</td>
<td>39.462</td>
<td>-2.599</td>
<td>-0.254</td>
<td>-0.345</td>
<td>-6.677</td>
<td>-8.207</td>
<td></td>
<td>75</td>
<td>0.690</td>
<td>12.57</td>
<td>0.317</td>
<td>2685</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>(1.05)</td>
<td>(1.96)</td>
<td>(2.15)</td>
<td>(9.85)</td>
<td>(1.95)</td>
<td>(2.05)</td>
<td>(2.66)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: (1a) is the original Milanovic (1994) equation with 80 observations; values in parentheses are the complements of the level of confidence with which the null hypothesis is rejected. For example, 0.21 in the first column indicates that the hypothesis of the first parameter being equal to zero can be rejected at the 21 percent confidence level.

Absolute value of \( t \)-statistics in parentheses, except equation (1a). The 1 percent and 5 percent critical values for the one-tail \( t \)-statistics are 2.38 and 1.67, respectively; Adj. \( R^2 \) is coefficient of determination adjusted for the number of variables, and RSS is a residual sum of squares. Heteroscedasticity is the simple test of the unconditional homoscedasticity assumption, distributed as \( \chi^2(1) \). Normality test is based on a test of skewness and kurtosis of residuals, distributed as \( \chi^2(2) \). The Lagrange multiplier (LM) test is the probability of rejecting the null hypothesis that the parameters of the new explanatory variables are jointly equal to zero. For example, in equation 2, a value of 2 means that the null hypothesis can be rejected at approximately the 2 percent significance level.
Table 4. The Augmented Kuznets Hypothesis: Is There a Kink in the Inflation Effect?  
(Ordinary least squares (OLS) and instrumental variable technique (IV), heteroscedastic-consistent standard errors)

<table>
<thead>
<tr>
<th>Eq.</th>
<th>Constant</th>
<th>Y</th>
<th>Y²</th>
<th>State Employment</th>
<th>Transfers</th>
<th>High Inflation</th>
<th>Low Inflation (B)</th>
<th>Very Low Inflation</th>
<th>No. of obs.</th>
<th>Adj. $R^2$</th>
<th>Heteroscedasticity</th>
<th>Normality</th>
<th>RSS</th>
<th>LM Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>-84.07</td>
<td>38.552</td>
<td>-2.531</td>
<td>-0.249</td>
<td>-0.401</td>
<td>-6.605</td>
<td>-8.783</td>
<td>-5.953</td>
<td>75</td>
<td>0.697</td>
<td>11.42</td>
<td>0.154</td>
<td>2584</td>
<td>4</td>
</tr>
<tr>
<td>OLS</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>-89.02</td>
<td>39.987</td>
<td>-2.635</td>
<td>-0.255</td>
<td>-0.357</td>
<td>-6.599</td>
<td>-8.879</td>
<td>-6.086</td>
<td>75</td>
<td>0.697</td>
<td>11.72</td>
<td>0.069</td>
<td>2588</td>
<td>3</td>
</tr>
<tr>
<td>IV</td>
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<tr>
<td>5</td>
<td>-89.03</td>
<td>37.633</td>
<td>-2.476</td>
<td>-0.262</td>
<td>-0.388</td>
<td>3.416</td>
<td>2.935</td>
<td>2.935</td>
<td>71</td>
<td>0.694</td>
<td>11.07</td>
<td>0.361</td>
<td>2457</td>
<td>16</td>
</tr>
<tr>
<td>OLS</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>5</td>
<td>-93.23</td>
<td>38.828</td>
<td>-2.563</td>
<td>-0.267</td>
<td>-0.351</td>
<td>3.511</td>
<td>2.885</td>
<td>2.885</td>
<td>71</td>
<td>0.694</td>
<td>11.43</td>
<td>0.252</td>
<td>2460</td>
<td>18</td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

Notes: Absolute value of t-statistics in parentheses. The 1 percent and 5 percent critical values for the one-tail t-statistics are 2.38 and 1.67, respectively; Adj. $R^2$ is coefficient of determination adjusted for the number of variables, and RSS is a residual sum of squares. Heteroscedasticity is the simple test of the unconditional homoscedasticity assumption, distributed as $\chi^2(1)$. Normality test is based on a test of skewness and kurtosis of residuals, distributed as $\chi^2(2)$. The Lagrange multiplier (LM) test is the probability of rejecting the null hypothesis that the parameters of the new explanatory variables are jointly equal to zero.
natural logarithms. Clearly, the parameters are not affected. While we experimented with various instruments, none of them changed the OLS results in a significant way.

**Effects of Inflation and Financial Deepening on Income Inequality**

What is the impact of the newly added variables? Inflation increases income inequality, and the impact is strongest in hyperinflation countries. The largest improvement in income distribution, compared with the hyperinflationary subsample, is in the group of low-inflation countries (0–40 percent annually). Within this group, however, countries with very low inflation (below 5 percent annually) seem to benefit less from the virtual price stability than the countries in the 5–40 percent annual inflation range.

The results are as follows. First, hyperinflation dramatically worsens income distribution: the four hyperinflationary countries face an increase of 8 points in the Gini coefficient over the average of 50 Gini points for the rest of the sample (Table 3, equation 2). Second, countries with either high or low inflation have Gini coefficients that are lower by about 7 or 8 Gini points, respectively, than countries with hyperinflation (Table 3, equation 3). On inspection, these results are fairly invariant with respect to the technique used.

Third, we find that the impact of inflation on income distribution has a kink at very low rates of inflation. As a sign of parameter misspecification, the estimated parameters for high inflation and low inflation in equation 3 are statistically indistinguishable, see below. Hence, equation 4 of Table 4 uses the distinction between low and very low inflation. While the improvements in high and low inflation compared with hyperinflation remain at around 7 and 9 Gini points, respectively, very low inflation implies only a modest gain in income distribution compared with hyperinflation, slightly below even that of high inflation (6 Gini points). These results are confirmed by running regressions on nonhyperinflationary countries only (equation 5). The estimated parameters imply an outturn for very low inflation worse by some 3 Gini points than that for low inflation and also a worse outturn than in the case of high inflation. These results are statistically significant using the one-tail 5 percent threshold.

On inspection, the estimated dummies for the various levels of inflation have similar values, especially those for high and low inflation, and high and very low inflation. Therefore, the question is: are the differences in the estimated inflation coefficients statistically significant? To answer this question, we calculate the Wald tests for all pairs of inflation parameters estimated in equations 3, 4, and 5 in Tables 3 and 4 (see Table 5). On the one hand, the null hypothesis of identical values of parameters can be rejected at about the 7 percent significance level or less for all inflation rates vis-à-vis hyperinflation (in equations 3 and 4) and also

---

18Note that in equation 3 only two levels of inflation are distinguished: high inflation (dummy is 1 if inflation is over 40 percent annually and below 300 percent; zero otherwise); and low inflation (dummy is 1 if inflation is less than 40 percent; zero otherwise).

19However, inflation dummies are jointly significant at the 5 percent significance level. (See the Lagrange multiplier test in Tables 3 and 4.)
very low inflation is distinguishable from low inflation (equation 4). On the other hand, the high-inflation parameter fails this test badly vis-à-vis the low-inflation (A) parameter in equation 3, signaling possible parameter misspecification. By breaking the low-inflation (A) sample into low-inflation (B) and very-low-inflation subsamples (equation 4), the significance level of the nonzero difference between high and low inflation now improves markedly, even though it remains less than fully convincing. The Wald test confirms that the impact of high inflation is indistinguishable from that of very low inflation. Finally, the estimation without hyperinflationary countries (equation 5) brings perhaps the most convincing results: the null hypothesis of the nonzero difference between high and low inflation can be rejected at about the 7 percent significance level. As before, very low inflation remains different from low inflation, but not from high inflation.

How Important Are the Newly Added Variables for Income Inequality?

The next question is threefold. First, what is the importance of inflation compared with the Milanovic social choice factors? Second, does the impact of inflation depend on the level of development? Third, does the impact of inflation depend on the location of the country? Using a simple comparative static analysis, we aim to show that the effect of inflation is, on average, almost as strong as that of the social

---

\footnote{Most likely, it would be possible to find such breakpoints among inflation rates that would minimize the values of the Wald test. However, we preferred to refrain from further data mining.}
choice variables (it is certainly stronger in low-income countries), and that the benefits of low inflation are evenly spread across income levels and regions.

Inflation clearly exerts a strong impact on income distribution, but how exactly is the impact distributed across the levels of development? Using the estimated coefficients from equation 4 of Table 4, we separate the effects of income variables, Milanovic social choice variables, and the inflation variables on income distribution. Those effects are smoothed and plotted against GDP per capita (Figure 1). First, taking into account an intercept and the Kuznets factors only (solid line) overestimates the actual income inequality, as shown by the empty squares. Second, including the social choice variables shifts the Kuznets curve downward and pivots it at the intercept (long-dashed line). Finally, inflation shifts the Kuznets curve further downward (short-dashed line). The narrowing effect on income distribution of lower inflation seems to be fairly independent of the level of development, and if anything, the effect of inflation is stronger in low- and high-income countries than in middle-income countries.

Numerically, the average effect of the additional variables (and unexplained errors) is somewhat less than 20 Gini points (see Table 6). The average effect of inflation is rather stable, at about 7–8 Gini points. In contrast to Milanovic, the gap between the simple Kuznets hypothesis and the actual Gini coefficients owing to social choice variables widens earlier, at about US$4,501–6,000 per capita. As before, the impact of social choice variables is strongest in the high-income countries and, on average, their impact is somewhat larger than the aggregated impact of the inflation variables. As predicted, the correlation between the effects of social choice variables and inflation on income distribution is close to zero (−0.13).

Further insights can be obtained from an analysis of the relative impact of inflation at different levels of development (Table 6). Low-income countries (from US$501–3,000 per capita) benefit from low inflation, which improve their theoretical income distribution by about 8 Gini points, or by almost double the amount generated by the social choice variables. The relationship is reversed, however, in the three upper brackets of income per capita (over US$5,401): social choice variables are twice as important in explaining deviations from the simple Kuznets hypothesis. Middle-income countries (US$3,001–6,000 per capita) gain relatively little from lower inflation: this can be attributed mostly to the larger proportion of high-inflation countries among this group.

To summarize, while lowering income inequality through the social choice variables is likely to be costly and may be open only to middle- or high-income countries, substantial income equality gains seem to be obtained through low inflation at any stage of development. In fact, only with income per capita of more than US$4,500 can a country expect effects of social choice variables to outweigh significantly the positive effect of low inflation.

The effects of the newly introduced variables are even more eye opening when countries are sorted regionally (Table 7). Clearly, the less-developed regions have

---

21Equations 3 and 4 produced very similar aggregated results.
22Social choice variables and inflation are set equal to zero.
23Inflation is set equal to zero.
more to gain from price stability than members of the Organization for Economic Cooperation and Development (OECD). Only in Europe (OECD countries are almost the same subsample), owing to massive transfers, and in Eastern Europe, because of state employment, is the effect of the social choice variables significantly stronger than that of inflation. By way of comparison, the effect of inflation in Africa and Asia is double that of the social choice variables.

Do the results confirm the special status of certain regions? Only two regions, Africa and Asia, have relatively large unexplained residuals. Africa’s inequality is higher than the estimated value, Asia’s inequality is lower. Still, these residuals seem to be far too small to conclude that the Kuznets hypothesis is a result of a few regionally concentrated outliers.

III. Conclusions and Policy Implications

This paper offers a contribution to the income inequality literature within the traditional Kuznets model. Lower inflation rates—in addition to the level of development and fiscal redistribution—are found to improve income equality and their impact is uniform for all levels of GDP per capita. In line with the cost-of-inflation literature, the negative impact is most pronounced during hyperinflation. Effects of price stabilization on income distribution are nonlinear—countries with inflation below 5 percent a year seem to benefit less than countries with inflation between 5 percent and 40 percent.
### Table 6. Impact of Selected Variables on Income Distribution at Different Income Levels
(Simple unweighted averages, in Gini points)

<table>
<thead>
<tr>
<th>Per Capita GDP (in U.S. dollars)</th>
<th>Actual Gini</th>
<th>Kuznets Hypothesis</th>
<th>Total Effect of Additional Variables</th>
<th>Of which: Inflation</th>
<th>Unexplained Part of Gini Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 1,500</td>
<td>50.7</td>
<td>61.4</td>
<td>-10.7</td>
<td>-3.8</td>
<td>0.5</td>
</tr>
<tr>
<td>1,501–3,000</td>
<td>46.0</td>
<td>62.8</td>
<td>-16.8</td>
<td>-6.2</td>
<td>-2.0</td>
</tr>
<tr>
<td>3,001–4,500</td>
<td>48.2</td>
<td>61.8</td>
<td>-13.6</td>
<td>-8.1</td>
<td>1.2</td>
</tr>
<tr>
<td>4,501–6,000</td>
<td>42.9</td>
<td>60.6</td>
<td>-17.7</td>
<td>-12.5</td>
<td>1.3</td>
</tr>
<tr>
<td>6,001–10,000</td>
<td>31.4</td>
<td>58.7</td>
<td>-27.4</td>
<td>-17.0</td>
<td>-2.3</td>
</tr>
<tr>
<td>Over 10,000</td>
<td>31.8</td>
<td>53.8</td>
<td>-22.0</td>
<td>-13.8</td>
<td>0.0</td>
</tr>
<tr>
<td>Average</td>
<td>41.7</td>
<td>59.2</td>
<td>-17.5</td>
<td>-9.8</td>
<td>-0.5</td>
</tr>
</tbody>
</table>

Source: Calculations based on equation 4 (OLS) in Table 4.

1Income variables and an intercept. All other parameters set equal to zero.

2The difference between the actual Gini coefficients and predictions from the simple Kuznets hypothesis.

3State employment as percentage of total employment and transfers as percentage of GDP.

4Relative to hyperinflationary countries. For definitions of variables see the text.
Table 7. Impact of Selected Variables on Income Distribution in Different Regions
(Simple unweighted averages, in Gini points)

<table>
<thead>
<tr>
<th></th>
<th>Per capita GDP (in U.S. dollars)</th>
<th>Number of Countries</th>
<th>Actual Gini</th>
<th>Total Effect of Additional Variables</th>
<th>Of which: Social choice</th>
<th>Inflation</th>
<th>Unexplained Part of Gini Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>1,832</td>
<td>17</td>
<td>51.5</td>
<td>-10.2</td>
<td>-5.2</td>
<td>-8.1</td>
<td>3.2</td>
</tr>
<tr>
<td>Asia</td>
<td>4,829</td>
<td>14</td>
<td>42.2</td>
<td>-18.1</td>
<td>-5.2</td>
<td>-8.0</td>
<td>-4.9</td>
</tr>
<tr>
<td>Latin America</td>
<td>4,207</td>
<td>16</td>
<td>50.6</td>
<td>-10.7</td>
<td>-6.6</td>
<td>-6.2</td>
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</tr>
<tr>
<td>Europe&lt;sup&gt;3&lt;/sup&gt;</td>
<td>11,075</td>
<td>20</td>
<td>30.9</td>
<td>-24.9</td>
<td>-15.0</td>
<td>-7.7</td>
<td>-2.1</td>
</tr>
<tr>
<td>Eastern Europe</td>
<td>5,700</td>
<td>4</td>
<td>26.6</td>
<td>-33.6</td>
<td>-29.4</td>
<td>-5.3</td>
<td>1.2</td>
</tr>
<tr>
<td>Developed countries&lt;sup&gt;6&lt;/sup&gt;</td>
<td>12,911</td>
<td>22</td>
<td>30.6</td>
<td>-23.8</td>
<td>-14.7</td>
<td>-8.0</td>
<td>-1.0</td>
</tr>
</tbody>
</table>

Source: Calculations based on equation 4 (OLS) in Table 4.

1Income variables and an intercept. All other parameters set equal to zero.
2The difference between the actual Gini coefficients and predictions from the simple Kuznets hypothesis.
3State employment as percentage of total employment and transfers as percentage of GDP.
4Relative to hyperinflationary countries. For definitions of variables see the text.
5Excluding Eastern European countries.
6Members of the Organization for Economic Cooperation and Development (OECD).
INCOME INEQUALITY: DOES INFLATION MATTER?

What are the policy implications? In the author's view, price stabilization offers a free lunch: there are no medium- or long-term income inequality costs of disinflation, only benefits. The improvement in income distribution from a hyper-inflationary to a high-inflation steady state is substantial, and the benefits of moving from high to low inflation are tangible. Only in middle- and high-income countries (GDP per capita of US$4,501 or more) do social choice variables outweigh the impact of low inflation.

Our results are difficult to compare with alternative research, because very few cross-country studies have included inflation as an explanatory variable for income inequality. It remains to be seen if our results can be confirmed in a large cross-country or pooled sample, or in a sample with different definitions of income distribution.

APPENDIX
A Model

The general equilibrium model features an infinite number of periods and a single consumption good. Each worker receives a wage stream \( y_t \), which is a product of the wage rate and hours worked, and consumes \( c_t \) (real) units of the good in each period. The worker also trades in one nominal asset, that is, currency, \( w_t \), which returns \((1 - n_{t+1})\) in period \( t + 1 \), where \( n \) is inflation. If \( n \) is positive, the value of savings in terms of the consumption goods declines. In each period, the worker must allocate her wage and nonwage income between consumption and the future holdings of the nominal asset. Therefore, she faces the usual budget constraint:

\[
y_t + (1 - n_t)w_{t-1} = c_t + w_t.
\]

(A1)

From the budget constraint, it follows that the worker has two sources of income: wage income and the nominal asset. For simplicity, assume that the worker is endowed with a stock of nondepreciating human capital \( (h) \) that does not require further investment in education. The worker is paid her marginal product \( (m) \), which also defines the usual demand schedule for labor:\footnote{See, for example, Blanchard and Fischer (1989).}

\[
L^d \equiv \text{wage rate} = m(h)
\]

(A2)

The amount of labor supplied is affected by the change in the price level: \( L^s = l(\pi, \ldots) \).\footnote{One can consider a more extreme version of the model, in which wealth directly enters the wage function, \( wage_t = m(h(w_{t-1}(\pi_t))) \). Past wealth is needed to buy health, education, or social status in a broad sense of the word (club membership, travel, reputable housing and schooling, etc). These "attributes of success" would then raise the worker's marginal product of labor.}

First, inflation shifts the labor supply schedule inward, lowering the amount of hours worked and, eventually, also the worker's total earnings \( (\partial y/\partial \pi < 0) \) as the worker responds to inflation-induced losses. Second, inflation reduces the value of a nominal asset \( (w) \) held by the workers. The loss stemming from negative real returns can be avoided only if inflation is fully anticipated and if the holding of \( w \) can drop to or below zero.

Because of these costs, inflation unambiguously reduces resources available for consumption both by limiting the amount of hours worked and by generating a loss in the asset principal,

\[
c_t = y_t(h, \pi_t) + (1 - n_t)w_{t-1} - w_t
\]

(A3)

as both terms in \( \partial c/\partial \pi \) are negative.
The worker chooses $c_t$ and $w_t$ in each period to maximize the expected utility function

$$\max E_t \left[ \int_0^T u(c_{t+j}) \, dt \right], \quad (A4)$$

subject to the above budget constraint, where $E_t$ denotes the worker’s expectation at the beginning of period $t$ and $\beta = 1/(1 + r)$ denotes her subjective discount factor.

The solution to the worker’s problem requires that

$$\frac{\partial m(n^*)}{\partial n_t} = -w_{t-1} \quad (A5)$$

and

$$E_t \beta^{n+1} \frac{\partial u_{n+1}(c^*)}{\partial c_{n+1}} = E_t \beta (1 - \pi_t) \frac{\partial u_t(c^*)}{\partial c_t}, \quad (A6)$$

in each period $t = 0, 1, 2, \ldots$

Equation (A5) shows that, under uncertainty, the loss of wage income owing to higher inflation must be compensated by higher wealth in $t - 1$ to keep the worker’s utility unchanged. Equation (A6) then states that marginal utility of consumption declines with inflation. Because both $(1 - \pi)$ and $u'(c_{t-1})u'(c_t)$ cannot be predicted with the available information set, consumption follows a random walk.\footnote{Employing a simple logarithmic utility function, $u_t = \ln(c_t)$, equation (A6) can be rearranged to yield the random walk property:

$$c_{t+1} = \phi c_t + \varepsilon_t,$$

where $\phi = 1/[\beta(1 - \pi_t)]$ and $\varepsilon_t$ is an error term.}

Moreover, one can confirm that inflation lowers wealth:

$$\frac{\partial w}{\partial \pi} = -\beta \lambda_t + \lambda_t \frac{\partial^2 y}{\partial n^2} < 0 \quad (A7)$$

as the change in the value of the asset is negative.

REFERENCES


INCOME INEQUALITY: DOES INFLATION MATTER?


Welfare Effects of Uzbekistan's Foreign Exchange Regime

CHRISTOPH B. ROSENBERG and MAARTEN DE ZEEUW*

In addition to transferring about 16 percent of GDP from exporters to importers, Uzbekistan's quasi-fiscal multiple exchange rate regime generates identifiable welfare losses of 2–8 percent of GDP on import markets and up to 15 percent on export markets. These excess burdens have increased substantially with the growing difference among exchange rates. The welfare analysis allows some conclusions regarding the optimal reform strategy: (i) welfare losses will decline overproportionally as exchange rates unify, (ii) exchange rate unification should be supplemented by changing the explicit fiscal system; (iii) at a minimum, Uzbekistan would benefit from moving to an explicit fiscal regime. [JEL F31, H29]

In January 1997, Uzbekistan formally (re)introduced a system of multiple exchange rates and restrictions on current account transactions with the aim of promoting import substituting industries, protecting foreign exchange reserves, and subsidizing basic food imports. Several recent studies have dealt with the effects of this system on sectoral distribution, foreign investment, and macroeconomic stability. However, its consequences for economic efficiency and welfare, while acknowledged, have so far received little attention. This paper, which builds on an earlier article by Rosenberg, Ruocco, and Wiegard (1999), tries to address this question. Specifically, it attempts to identify and quantify the substantial microeconomic distortions on export and import markets that result from the exis-

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tence of at least three distinct exchange rates in Uzbekistan. This analysis also shows how a simple exercise in welfare economics can provide insights into the appropriate sequencing of reforms. The approach presented here may thus serve as a blueprint for structural policies aiming at the removal of distortions in general.

I. Uzbekistan’s Foreign Exchange Regime Since 1996

Uzbekistan is one of only a few transition countries\(^2\) that operates a segmented foreign exchange market and multiple exchange rates, in connection with strict controls of export and import markets. After a period of foreign exchange and trade liberalization in 1995–96, this system was first created as an emergency measure in response to growing balance of payment pressures following an unexpected deterioration of the country’s terms-of-trade position. Since then, the authorities have justified the continued—and intensified—use of current account restrictions with a need to direct resources from traditional exports (such as cotton, gold, minerals) to the development of a capital-intensive, import-substituting industrial base (for example, automobiles, energy, chemistry) and to subsidize socially important consumer good imports. The foreign exchange regime has thus become the cornerstone of the so-called “Uzbek model of development,” which emphasizes a dominant role of the state during the transition process. More fundamentally, this system emerged in response to a general lack of market reforms, especially in the fiscal sphere.

In practice, Uzbekistan’s foreign exchange market is split into three segments:\(^3\) two official and one unofficial. In 1997, the largest segment was the so-called auction market at the Uzbek Republican Currency Exchange (URCE). In this market, the government determines administratively an appreciated exchange rate, well below the market clearing level. Since at this rate, demand for foreign exchange exceeds supply, the government has to restrict access and enforce supply. The supply of foreign exchange to the URCE mainly derives from the mandatory surrender of all foreign exchange proceeds from “centralized exports,” in particular gold and cotton fiber, which make up about two-thirds of the country’s total export earnings. On the demand side, the Republican Monetary Commission (RMC) decides who may buy foreign exchange at the URCE and how much. Access to the auction market rate is granted to certain importers of capital goods, raw materials, grains, and some high-priority consumer goods, as well as enterprises servicing foreign loans guaranteed by the government. Requests for foreign exchange have to be submitted by selected banks on behalf of their clients. The government itself also acquires foreign exchange at the URCE, mainly in order to service its own external debt. Starting in mid-1998,

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\(^2\)Among the countries of the Baltics, Russia, and other countries of the former Soviet Union, only Turkmenistan applies foreign exchange regimes similar to that of Uzbekistan.

\(^3\)Strictly speaking, the description of the foreign exchange regime covers only the period from January 1998 to June 2000. On July 1, 2000, and July 1, 2001, the authorities introduced a number of measures that further segmented the foreign exchange market. These changes are not covered by this paper. They do not, however, alter the substance of the analysis.
access to this market became somewhat more restricted (at least by law). Commercial banks were generally granted access to the URCE at the more depreciated commercial bank exchange rate (see below) with the profit from the exchange rate difference accruing to the central bank.

The second official segment of Uzbekistan’s foreign exchange market is the commercial bank market, where commercial banks and exchange bureaus trade foreign exchange with other banks, enterprises, and individuals. Formally, the commercial exchange rate is freely determined, but in practice, it is administratively set by the government below the market clearing level. Until mid-1998, this rate was not allowed to deviate by more than 12 percent from the auction market exchange rate, but following a decree of July 1, 1998, this margin has been adjusted upward.

In response to excess demand at this appreciated rate, the government also restricts access and enforces supply in this market. On the supply side, exporters in 1997 and 1998 had to surrender 30 percent of all foreign exchange proceeds from decentralized (that is, non-gold and non-cotton fiber) exports. Effective January 1, 1999, the surrender requirement was increased to 50 percent. The mandatory surrender had to be at the more appreciated auction rate until July 1, 1998 but is now at the commercial bank rate. In this connection, the buy/sell spread for commercial banks has been reduced to about 3 percent from 12 percent. In addition, the Central Bank of Uzbekistan (CBU) sells foreign exchange to commercial banks from the 100 percent surrender for centralized exports; in doing so, the CBU benefits from the growing spread between the auction rate and the commercial bank rate (see Box 1). On the demand side, only a limited number of traders are permitted to buy foreign exchange at the commercial bank market, and they need to obtain a special license and a foreign exchange quota from the RMC. Individuals are only allowed to purchase small amounts of foreign exchange for a very limited number of purposes, such as pilgrimages or authorized study abroad.

An inevitable consequence of these strict regulations of official markets for foreign exchange is the emergence of an unofficial (illegal) curb market for foreign exchange. The exchange rate on this market is largely determined by the demand that cannot be satisfied on the two official markets. Therefore, the curb market premiums reflect, inter alia, the extent to which access to the official markets is restricted. The mark-up for foreign exchange on the domestic curb market was about 100 percent until mid-1998, but has since increased to more than 400 percent (see Figure 1).

In addition, there is a non-cash offshore curb market where the exchange rate is up to 50 percent more depreciated than at the domestic curb market, due to the existence of cash withdrawal restrictions in Uzbekistan’s banking system. The size of this market, however, is unknown, and it is less observable than the other three. For the sake of simplicity, this market segment is excluded from the remaining analysis.

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Box 1. Quasi-Fiscal Operations Through the Central Bank

The decree of July 1, 1998 opened a new source of profit for the CBU, as it was now allowed to buy foreign exchange at the auction rate and sell it at the more depreciated commercial banks' exchange rate. In conventional accounting terms, this profit is recorded in the capital accounts of the CBU’s balance sheet. These are augmented every time the CBU sells foreign exchange to a licensed importer or a commercial bank. Ceteris paribus, these foreign exchange operations have reduced the growth of reserve money as the CBU withdrew money from the economy by implicitly taxing exporters. They, therefore, acted as an automatic stabilizer within a rather loose monetary policy.

This accounting profit only partly reflects the quasi-fiscal operation incurred by a central bank in a situation with a parallel market-determined exchange rate. In economic terms, the central bank makes an implicit profit or loss every time it buys or sells foreign exchange at the artificially appreciated exchange rate (see, for example, Agenor and Ucer, 1995, pp. 26–27). This is because the true market clearing exchange rate more accurately reflects the true marginal value of foreign exchange than the overvalued official exchange rates. Thus, there is an implicit tax (subsidy) associated with the central bank’s foreign exchange operations if it is a net buyer (seller) of foreign exchange. This holds even in a situation where the central bank sells foreign exchange at the same rate as it buys it.

The table below summarizes the CBU’s quasi-fiscal operations due to the existence of multiple exchange rates, including buying and selling foreign exchange at below market rates. To do this, one needs to estimate the true market exchange rate, and here we choose a weighted average of the existing exchange rates using the relative share of the three market segments.

<table>
<thead>
<tr>
<th></th>
<th>1997 1st half</th>
<th>2nd half</th>
<th>1998 1st half</th>
<th>2nd half</th>
<th>1999 1st half</th>
<th>2nd half</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CBU inflows</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Gold production</td>
<td>894</td>
<td>1,292</td>
<td>938</td>
<td>1,125</td>
<td>729</td>
<td>784</td>
</tr>
<tr>
<td>Centralized exports (mainly cotton)</td>
<td>392</td>
<td>359</td>
<td>341</td>
<td>339</td>
<td>323</td>
<td>337</td>
</tr>
<tr>
<td><strong>CBU outflows</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBU direct sales for priority purposes</td>
<td>1,441</td>
<td>1,501</td>
<td>1,095</td>
<td>982</td>
<td>984</td>
<td>576</td>
</tr>
<tr>
<td>CBU sales to commercial banks</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>480</td>
<td>481</td>
<td>174</td>
</tr>
<tr>
<td><strong>Balance of implicit taxes (+)</strong> and subsidies (–) (as a percentage of GDP)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Because of different legal exchange rates</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Because of buying/selling below estimated market clearing exchange rate</td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Memorandum item</strong>: Estimated market clearing exchange rate (average, sum per U.S. dollars)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: CBU; and authors’ own calculations.

1The accounting profit can be calculated as the difference between the two exchange rates multiplied by the amount of foreign exchange sold. See Mackenzie and Stella (1996), pp. 20–21.

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Figure 2 shows foreign exchange flows in Uzbekistan's two official markets in the three years following the introduction of convertibility restrictions in late 1996. Total inflows declined because low commodity prices (especially for gold and cotton) in combination with the overvalued official exchange rate, convertibility restrictions, and a general deterioration of the business climate led to a decline in exports and foreign direct investment, as well as an increase in unofficial capital outflows. As one can see from Figure 2, the government reacted to this trend by curtailing currency conversions for imports and by drawing down foreign assets. In addition, there were substantial unrecorded foreign exchange transactions on the illegal curb market. One estimate by the World Bank (1999, p. 113) puts purchases on this market segment in 1997 at some US$1.4 billion or 26 percent of all foreign exchange sales, excluding capital account transactions (Table 1).5

The shares of the three market segments have shifted markedly since 1996. Following the essence of the decree in July 1998, some foreign exchange purchases were moved from the auction market (at the official exchange rate) to the commercial bank market (at the commercial bank exchange rate). The curb

5Sales of foreign exchange may in fact be higher, as households and enterprises build up cash foreign exchange assets. Persistently high inflation rates, restrictions in the banking system, and negative real interest rates discourage savings in national currency.
Figure 2. Foreign Exchange Flows through the Banking System
(In millions of U.S. dollars)

- Foreign Exchange Inflows
  - Centralized exports (mainly cotton)
  - Gold production
  - Enterprise sales to commercial banks

- Foreign Exchange Outflows
  - Commercial banks' sales
  - CBU direct sales for priority purposes

- International Reserves and Net Flows

Sources: CBU, authors' own calculations.
II. Quasi-Fiscal Operations Through the Foreign Exchange Regime

Governments can collect revenues and redistribute income among sectors and household groups by means other than explicit taxes and subsidies. Such activities are usually referred to as quasi-fiscal operations because they are fiscal in all but name although they are often carried out by central banks and other public financial institutions. The Uzbek authorities use a wide range of such mechanisms, including multiple currency practices, inflation tax, subsidized and directed lending, non-remunerated reserve requirements and credit ceilings, price interventions in product markets, and wage regulation. Of these, the multiple currency regime is probably the most significant—although it is in the nature of quasi-fiscal operations that they cannot be easily quantified. According to one study (IMF, 1998, pp. 58–68), the array of implicit taxes and subsidies related to multiple currency practices amounted to almost 13 percent of GDP in 1997, if one assumes a hypothetical market clearing rate for that year of sum 100 per U.S. dollar. As will be shown below, the size of these government activities increased in the years 1998–99, as the difference between the official exchange rates and the true market clearing rate widened. In addition, the changes introduced in July 1998 made the system more complex with regard to the CBU’s quasi-fiscal operations (see Box 1).

6 Since no estimates of the size of the curb market in 1998 and 1999 are available, it is assumed to have increased slightly to 35 percent of all transactions. Note, however, that this assumption influences the calculation of the indicative exchange rate, the U.S. dollar denominated GDP, and ultimately the size of the welfare effects described below.

7 For a survey of quasi-fiscal operations in general, see Mackenzie and Stella (1996).

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In this paper, we concentrate on the immediate impact of multiple exchange rates on legal export and import markets alone, that is, we abstract from their side effects on illegal trade, households, banks, and the budget. These are partly dealt with in IMF (1998, pp. 58–68) and World Bank (1999, pp. 17–24).

The quasi-fiscal impact of Uzbekistan’s multiple exchange rate regime on exporters and importers arises from the difference between the administratively set official exchange rate and the true market clearing exchange rate (that is, the rate that would emerge in the absence of all current account restrictions). Exporters that are forced to sell their foreign exchange earnings at the overvalued official exchange rate pay an implicit tax. Conversely, importers that are allowed to buy foreign exchange rate at the official exchange rate are granted an implicit subsidy.\(^8\)

Table 2 shows the implicit tax rate applying to (legal) exports and the implicit subsidy applying to (legal) imports for 1997–99. The indicative (equilibrium) exchange rate is calculated as the weighted average of the three existing exchange rates, using the market shares shown in Table 1. This is, of course, only a rough approximation of the true market clearing rate, which would depend on factors beyond the scope of this paper. However, the indicative exchange rate may suffice to illustrate the magnitude of transfers and distortions involved.

Not surprisingly, implicit tax and subsidy rates applying to foreign trade operations more than doubled with the increase of the curb market premium that started in the summer of 1998. Note, however, that the implicit tax rate on non-centralized exports is much lower than that on centralized exports both because the more depreciated commercial bank exchange rate applies and only a part of foreign exchange receipts needs to be surrendered.

The size of the quasi-fiscal transfer between exporters and importers can be calculated by comparing the domestic currency equivalent of foreign exchange flows based on actually applied exchange rates with those based on the market clearing rate. Table 3 shows that producers of centralized exports are the main losers, paying an implicit tax to the tune of 12 percent of GDP in 1999, while the recipients of foreign exchange through official channels gained about 15 percent of GDP. Both the implicit tax and subsidy burden have increased over the last three years, despite the fact that the U.S. dollar value of foreign trade declined. In 1997, the subsidy for imports was higher than the tax on exports because the CBU drew down net reserves. After the changes to the foreign exchange regime in July 1998, the CBU moved from being a net loser to becoming a net gainer, which explains why for 1998 as a whole implicit taxes exceeded implicit subsidies. This trend continued in 1999, especially after the CBU substantially reduced its foreign exchange sales in the second half of the year (see Box 1).

Note that in addition to the transfer from legal exports to legal imports examined here, there is an equivalent implicit subsidization of illegal exports and implicit taxation of illegal imports, which benefit (suffer) from the overly depreciated curb market exchange rate. The size of this transfer cannot be quantified since the size of these illegal transactions is unknown. It can be assumed, however,

\(^8\)For a numerical example illustrating the functioning of Uzbekistan’s quasi-fiscal regime see Rosenberg and De Zeeuw (2000, p. 10).
Table 2. Uzbekistan: Implicit Tax and Subsidy Rates on Foreign Trade, 1997-99
(In percent, unless otherwise indicated)

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1998</th>
<th>1999</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Implicit tax rates</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centralized exports</td>
<td>26</td>
<td>37</td>
<td>56</td>
</tr>
<tr>
<td>Other exports</td>
<td>5</td>
<td>9</td>
<td>21</td>
</tr>
<tr>
<td><strong>Implicit subsidy rates</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centralized imports</td>
<td>26</td>
<td>37</td>
<td>56</td>
</tr>
<tr>
<td>Other imports</td>
<td>17</td>
<td>30</td>
<td>43</td>
</tr>
<tr>
<td><strong>Memorandum items:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surrender requirement on non-centralized exports</td>
<td>30</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>Official exchange rate (sum/U.S. dollar, average)</td>
<td>67</td>
<td>95</td>
<td>125</td>
</tr>
<tr>
<td>Commercial banks' exchange rate (sum/U.S. dollar, average)</td>
<td>75</td>
<td>105</td>
<td>163</td>
</tr>
<tr>
<td>Curb market exchange rate (sum/U.S. dollar, average)</td>
<td>150</td>
<td>270</td>
<td>540</td>
</tr>
<tr>
<td>Indicative exchange rate (sum/U.S. dollar, average)</td>
<td>90</td>
<td>151</td>
<td>285</td>
</tr>
</tbody>
</table>

Sources: CBU; and authors' own calculations.

that this set of quasi-fiscal transfers has increased with the widening of the exchange rate premium and the rise of the shadow economy.

Quasi-fiscal operations through the foreign exchange regime not only redistribute resources between sectors. As is the case with any government intervention that distorts relative prices, they also cause efficiency losses. In practice, these are manifested in many different ways: resources are diverted from sectors where Uzbekistan is likely to have a comparative advantage (for example, food and food processing) to large loss-making investments (such as the automobile industry); entrepreneurs spend more time thinking about how to circumvent cumbersome foreign exchange restrictions than how to improve their businesses; those companies who obtain import permissions sell their product at home or abroad at curb-market equivalent prices, reaping large profit margins; and barter trade increases since foreign exchange is unavailable.

In principle, the welfare effects of Uzbekistan's foreign exchange regime are the same as an equivalent explicit system of taxes and subsidies. For example, the government could levy an export tax equivalent to the difference between the official exchange rate and the hypothetical market clearing rate on centralized exports. Nevertheless, direct government interventions, such as price regulations, combined with outright rationing cause larger microeconomic distortions than interventions such as explicit taxes. The size of these excess burdens of multiple exchange rate practices is the subject of Section III.

The equivalence of explicit and implicit government intervention also applies to the welfare-theoretical argument that the government is unlikely to be sufficiently informed about consumers' preferences and investors' profits to make deci-
WELFARE EFFECTS OF UZBEKISTAN’S FOREIGN EXCHANGE REGIME

Table 3. Uzbekistan: Implicit Taxes and Subsidies on Foreign Trade, 1997-99
(In percent of GDP)

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1998</th>
<th>1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign exchange inflows</td>
<td>6.0</td>
<td>10.7</td>
<td>16.2</td>
</tr>
<tr>
<td>Centralized exports</td>
<td>5.2</td>
<td>8.1</td>
<td>11.8</td>
</tr>
<tr>
<td>Cotton</td>
<td>3.4</td>
<td>5.4</td>
<td>6.7</td>
</tr>
<tr>
<td>Gold</td>
<td>1.8</td>
<td>2.7</td>
<td>5.2</td>
</tr>
<tr>
<td>Other exports</td>
<td>0.9</td>
<td>2.6</td>
<td>4.4</td>
</tr>
<tr>
<td>Foreign exchange outflows</td>
<td>8.5</td>
<td>10.4</td>
<td>15.1</td>
</tr>
<tr>
<td>Centralized imports</td>
<td>7.0</td>
<td>6.3</td>
<td>7.1</td>
</tr>
<tr>
<td>Other imports</td>
<td>1.5</td>
<td>4.1</td>
<td>8.0</td>
</tr>
</tbody>
</table>

Sources: CBU; and authors’ own calculations.

Before turning to the exact nature and size of the welfare losses associated with Uzbekistan’s foreign exchange regime, let us review the reasons why an explicit fiscal regime would be preferable to the implicit system practiced now.

First, the present system suffers from a lack of transparency. Because of the hidden nature of quasi-fiscal operations, policy makers as well as voters have no clear picture of the existence of the tax or subsidy, its size, and the extent to which it was intended by the government. There is little accountability, putting the system at odds with a main principle of democratic administration. For example, the rules determining eligibility for currency conversion are established without a mandate by parliament. In a sense, implicit taxation is similar to tax evasion where the taxpayer does not report that he should pay tax—implicit taxation means that the government does not report that it is taxing.

Secondly, quasi-fiscal operations through the foreign exchange regime confine the government’s flexibility when conducting fiscal policies. While revenues from explicit taxation can be saved or spent on the provision of public and merit goods, which are recognized to be a welfare-neutral form of public expenditure, implicit tax “revenues” from Uzbekistan’s foreign exchange regime cannot be used for anything but the subsidization of certain industries. Thus, the system automatically generates distortions both on the revenue and expenditure side. The size of implicit subsidies, moreover, is determined arbitrarily by the

9See, for example, the following quote from an Uzbek government publication: “There is also great demand for foreign currency from shuttle traders importing consumer goods of unknown firms, without quality certificates. This cannot be considered sound from an economic point of view. Currency regulations, including restrictions on convertibility, prevent the influx of such goods” (Chepel, 1998).
amount of implicit tax revenues that are funding them. An explicit import subsidy combined with a free market for foreign exchange would not have these drawbacks.

Third, multiple exchange rate practices entail a considerable administrative burden. Issuing foreign exchange licenses and quotas is not only a costly and inefficient use of the government’s administrative resources, it also invites corruption and rent-seeking behavior. This is particularly the case if, as seen in Uzbekistan, many different agencies and officials are involved in the approval process. One of the macroeconomic implications is that such a cumbersome and corruption-prone system discourages foreign direct investment and exports, thus putting further pressure on the balance of payments.

Finally, multiple exchange rate practices introduce an element of uncertainty regarding the availability of foreign exchange. This encourages dollarization with all its associated problems for the sustainability of the banking system and monetary policy (see Baliño, Bennett, and Borensztein, 1999). More generally, it impedes planning by economic agents and implicitly imposes a risk premium to doing business in Uzbekistan.

III. The Welfare Costs of Multiple Exchange Rates

In this section we attempt to identify and quantify some of the welfare losses associated with Uzbekistan’s foreign exchange regime. As shown in Section II, there is no difference from the welfare analytical point of view between the effects of explicit and implicit taxes and subsidies. We can, therefore, use standard trade theory when analyzing the welfare costs associated with the quasi-fiscal operations, which is the subject of this paper. For simplicity, we abstract from other distortions in these markets, such as state procurement at below-market prices and government subsidies for inputs. We also omit an analysis of the welfare effects arising from the implicit subsidization of illegal exports and implicit taxation of illegal imports mentioned above. A formal variant of the model (described in the appendix) allows us to calculate the actual size of the net welfare losses involved, depending on some rough parameterizations.

Theoretical Considerations

The welfare effects of taxes and subsidies are typically examined in a static partial equilibrium model of an open economy using the concept of consumer and producer surpluses, the so-called Harberger triangles. A graphical exposition can be found in any standard textbook on foreign trade. For an application to the case of Uzbekistan’s quasi-fiscal foreign exchange operations, see Rosenberg, Ruocco,

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10As a result, Uzbekistan’s consistently ranks low in international comparisons of transparent business practices, such as the Corruption Perception Index published by Transparency International.

11Demonetization in Uzbekistan is evidenced by the decline of the ratio of broad money to GDP from about 14 percent in 1996 to less than 10 percent in 1999.

12These are partly analyzed in Rosenberg, Ruocco, and Wiegard (1999).
and Wiegard (1999). A similar analysis for Poland in the late 1980s was conducted by Tarr (1990).

First, consider the welfare effects on the exports side. If Uzbekistan is modeled as a small open economy (that is, it is a price taker for all of its exports), it faces a horizontal excess demand curve from the rest of the world. By imposing an implicit export tax (equivalent to the difference between world market prices at the official and the market clearing exchange rate), the government gains some implicit revenue in the form of cheap foreign exchange. On the other hand, the implicit export tax causes economic distortions and leads to a decrease of the producer surplus. In the small country case, the latter unambiguously outweighs the increase in consumer surplus and the country (on balance) loses economic welfare.

This may change if Uzbekistan is modeled as a sufficiently large exporter, for example, of cotton fiber. In this case, the country faces an upward sloping rather than horizontal excess world demand function. By imposing an implicit export tax and hence curtailing its own supply of cotton to world markets, Uzbekistan could tilt the terms of trade of cotton in its own favor and gain welfare at the expense of the rest of the world. In theory, the authorities could set an “optimal” exchange rate differential (equivalent to an optimal export tax) where the welfare gain and the implicit tax revenue outweigh the domestic distortions. The exact result will depend on the elasticities of demand and supply. When setting such an optimal export tax, the authorities may also want to take into account possible retaliations from trading partners as well as the size of the welfare cost imposed on the rest of the world. The latter may be of particular importance if Uzbekistan desires admission to the World Trade Organization.

Does Uzbekistan indeed have some monopolistic power on world cotton markets that would allow it to affect the international terms of trade in its favor? In the 1997-98 harvest season, Uzbekistan had a share in world exports of cotton fiber of about 15 percent (second after the United States) and a share in world production of about 6 percent, suggesting that it may indeed have some leverage to drive up world market prices by keeping its crop in stock. In practice, however, the country is very much dependent on the foreign exchange earned from its cotton crop and has therefore shown no signs that it is deliberately curtailing its supply. On the contrary, the authorities have made the increase of cotton yields one of their main priorities. Finally, the empirical evidence of the last few years does not seem to support a role for Uzbekistan as a price maker: while cotton production in Uzbekistan has steadily fallen, so have world cotton prices. We can therefore safely ignore the case of Uzbekistan as a large country.

Now consider the implicit subsidy granted to those importers who have access to foreign exchange at the preferential exchange rates. Again, Uzbekistan loses welfare if modeled as a small, price taking country for imports. In the unlikely event that Uzbekistan can be considered a “large country” (maybe for the import of specialized capital goods, such as cotton harvesting machines), the standard model leads to the conclusion that it unequivocally loses net welfare. This is because the improvement of the terms of trade for imported machinery is more...
than compensated by the loss of producer surplus due to subsidization. If the country wanted to use its market power, it should tax, not subsidize, certain capital goods imports.

Quantitative Analysis

The net welfare effects of implicit taxation and subsidization can be quantified by using a standard partial equilibrium model. For simplicity, consider the more realistic case of Uzbekistan as a small open economy, both for exports and imports. We assume a constant elasticity export supply function.

$$P^x = BX^\beta \quad \beta > 0$$  \hspace{1cm} (1)

with $P^x$ the export price (measured in foreign currency units) and $X$ the exported quantity and the export elasticity defined as

$$\varepsilon_{xp} = \frac{dX}{dP^x} \frac{P^x}{X} = \frac{1}{\beta}$$  \hspace{1cm} (2)

After a number of manipulations, which are shown in the appendix, the net welfare losses can be expressed as a function of implicit tax revenues and elasticities. Unfortunately, no estimates of the latter exist for Uzbekistan or a similar transition country. Recent research by Reinhart (1995) and Senhadji and Montenegro (1999) suggest that long-run export elasticities in resource-rich developing countries are around or below unity, while they tend to be higher for industrial countries. Tarr (1990) uses a long-run elasticity of 1.16 in his study of pre-liberalization Poland. In the absence of a firm estimate, we examine a range of elasticities between 0.5 and 1.5.

Table 4 shows the net welfare losses in 1997–1999 as a percent of GDP for these alternative export supply elasticities. Overall, welfare losses increase with export elasticities, which is in line with the Ramsey rule. Most importantly, our calculations show that welfare losses have increased more than proportionally during the past three years.\(^{13}\) As the difference between the administered exchange rates and the true market clearing exchange rate has widened, Uzbekistan’s foreign trade has become increasingly distorted and inefficient. This is, inter alia, reflected in the decline of foreign trade and the low quality of government-subsidized investments (“white elephants”).

The sensitivity analysis shows that for a plausible range of parameter values the welfare loss for centralized exporters is much larger than for other exporters facing a lower implicit tax burden. This is the case even if we assume that for centralized exports (mainly cotton and gold) the elasticity is less than unity, which

\(^{13}\)This confirms a standard result in the theory of taxation. See for example Connolly and Munro (1999, pp. 196–202).

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WELFARE EFFECTS OF UZBEKISTAN’S FOREIGN EXCHANGE REGIME


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<tr>
<th></th>
<th>1997</th>
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<tr>
<td><strong>Centralized exports</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Implicit tax rate (in percent)</td>
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<tr>
<td>Elasticity Net welfare loss (in percent of GDP)</td>
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<tr>
<td>0.5</td>
<td>0.42</td>
<td>1.09</td>
<td>3.22</td>
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<tr>
<td>1.0</td>
<td>0.88</td>
<td>2.34</td>
<td>7.47</td>
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<td>1.5</td>
<td>1.42</td>
<td>3.88</td>
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<td><strong>Other exports</strong></td>
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<tr>
<td>Implicit tax rate (in percent)</td>
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<tr>
<td>Elasticity Net welfare loss (in percent of GDP)</td>
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<tr>
<td>0.5</td>
<td>0.02</td>
<td>0.13</td>
<td>0.59</td>
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<tr>
<td>1.0</td>
<td>0.04</td>
<td>0.20</td>
<td>0.94</td>
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Sources: CBU; and authors' own calculations.

seems more likely, certainly in the short term. The results highlight the need to address the overvaluation of the official exchange rate and the 100 percent surrender requirement for cotton and gold producers. Unifying only the curb market exchange rate with the commercial banks’ exchange rate, as the authorities did on May 1, 2000 does little to reduce the efficiency losses entailed by Uzbekistan’s foreign exchange regime.

The calculation of the welfare effects of subsidizing imports is analogous to the export side. Table 5 shows the results, again for a range of plausible parameter values. As on the export side, the net welfare loss increased more than proportionally as the implicit subsidy rates more than doubled over the past three years. While in 1997 the total welfare loss due to these subsidies was less than 2 percent of GDP, it was in the range of 2 to 8 percent of GDP in 1999.

Note that in general one cannot simply add up the excess burdens from Table 4 and Table 5, not even if expressed in monetary terms. The reason is that the two distortions partly overlap each other, for instance when the subsidization of imports.

One may argue that the short-term supply elasticity of cotton is close to zero since inputs provided under the government procurement system are fixed and state orders aim at maximizing production irrespective of world prices. In practice, however, farmers have resorted to illegal exports in order to avoid the implicit taxation through the overvalued exchange rate. Therefore, their surrenders of cotton to the government for legal exports (which are captured here) in effect depend on the producer price in foreign currency terms.

In the absence of elasticity data for Uzbekistan we again rely on recent estimates for developing countries as benchmark. Reinhart (1995) calculated a mean import demand elasticity of -0.66 for a sample of 11 developing countries in 1970-91, while Senhadji (1998) found a mean elasticity of -1.24 from a sample of 23 developing countries in 1960-93. In several developing countries their values are substantially larger, which is why we also explore an import demand elasticity of -2.0.
Christoph B. Rosenberg and Maarten de Zeeuw


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<th></th>
<th>1997</th>
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<tr>
<td><strong>Centralized imports</strong></td>
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<tr>
<td>Implicit subsidy rate (in percent)</td>
<td>26</td>
<td>37</td>
<td>56</td>
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<tr>
<td>Elasticity</td>
<td>Net welfare loss (in percent of GDP)</td>
<td>0.52</td>
<td>0.72</td>
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<tr>
<td>0.5</td>
<td>0.98</td>
<td>1.33</td>
<td>2.51</td>
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<tr>
<td>1.0</td>
<td>1.79</td>
<td>2.32</td>
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<tr>
<td><strong>Other imports</strong></td>
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</tr>
<tr>
<td>Implicit subsidy rate (in percent)</td>
<td>17</td>
<td>30</td>
<td>43</td>
</tr>
<tr>
<td>Elasticity</td>
<td>Net welfare loss (in percent of GDP)</td>
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<td>0.37</td>
</tr>
<tr>
<td>0.5</td>
<td>0.13</td>
<td>0.69</td>
<td>2.01</td>
</tr>
<tr>
<td>2.0</td>
<td>0.25</td>
<td>1.24</td>
<td>3.42</td>
</tr>
</tbody>
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Sources: CBU; and authors’ own calculations.

exporters partly compensates for the implicit tax imposed on them. Some other caveats are in place when drawing conclusions from these calculations: the additional welfare effects from implicitly taxing and subsidizing illegal trade are omitted; export and import markets are not independent from one another; consumer and producer surpluses are of limited importance in the case of multiple price changes; and results may change if Uzbekistan is modeled as a large open economy, especially on the export market for cotton. Finally, the standard “second best” argument holds.

IV. Conclusions and Policy Implications

This paper focuses on the welfare effects associated with the multiple exchange rate practices in Uzbekistan. An analysis of the implicit tax on centralized exports and the implicit subsidy on preferential imports shows that in 1999 there was a (measurable) net transfer of about 16 percent of GDP from exporters to importers. For plausible elasticity values, the efficiency loss caused by this quasi-fiscal operation is between 2 and 8 percent of GDP for importers and up to 15 percent of GDP for exporters, but may be much larger if the distortions in the growing illegal trade are included. The welfare loss is especially strong for central-

16In addition, Uzbekistan’s foreign exchange regime has implications for economic equity. The implicit tax on centralized exports (mainly cotton) is regressive, as it levies a heavy burden on the poorest part of the population, those working in agriculture. The same applies to the expenditure side: social assistance through price regulation is not targeted to the poor, but extended to all consumers of certain commodities, including the higher income groups. Moreover, rationing of scarce capital or foreign exchange is usually associated with favoritism and outright discrimination.
IZED EXCHANGES OF COFFEE AND GOLD, THE SECTORS WHICH ARE FACED WITH THE MOST UNFAVORABLE EXCHANGE RATES. WITH INCREASING IMPLICIT SUBSIDY RATES (MEASURED BY THE DIFFERENCE BETWEEN THE OFFICIAL AND HYPOTHETICAL MARKET CLEARING RATE), THE WELFARE LOSS ON THE IMPORT SIDE IS LIMITED TO THE AMOUNT ACTUALLY SPENT ON IMPORTED GOODS. WITH INCREASING IMPLICIT TAX RATES, THE WELFARE LOSS ON THE EXPORT SIDE INCREASES WITH THE ELASTICITY OF EXPORT SUPPLY AND IS THEORETICALLY UNLIMITED. WELFARE LOSSES MAY BE SOMEWHAT SMALLER IF UZBEKISTAN HAS SOME MONOPOLISTIC POWER ON THE WORLD COTTON MARKET.

Several policy conclusions arise from our analysis. First, Section II showed that even if the welfare effects of explicit and implicit taxes and subsidies are the same, there are several reasons why an explicit fiscal system would be preferable. These include considerations of: (i) transparency, accountability, and associated issues of governance; (ii) the government’s flexibility to conduct fiscal policy; (iii) the administrative costs; and (iv) uncertainty.

Secondly, the analysis shows that welfare losses rise more than proportionally with the implicit taxation or subsidization, approximated by the ratio of the curb market exchange rate and the official exchange rate. Thus, the rise of the curb market premium from 100 percent to more than 400 percent inflicts growing efficiency losses on the Uzbek economy, severely undermining the country’s ability to utilize its growth potential. From the economic policy point of view, our analysis at a minimum supports the conventional wisdom that the spread between these various exchange rates needs to be reduced, if not eliminated, as soon as possible.

Thirdly, the finding that excess burdens increase more than proportionally in response to an increase in tax or subsidy rates supports even a gradual dismantling of these distortions. If two distortions work in the same direction, the whole is larger than the sum of the parts. That is, the excess burden of the two distortions together is larger than the sum of the two excess burdens measured when each distortion is considered separately. For reform, this means that if only one of several cumulated distortions is removed, the beneficial effect on consumer or producer welfare will be more than proportional. If a gradualist reform approach would ever be effective, it would be in situations like these.

Finally, any reform of the existing foreign exchange regime will also need to take account of the fact that distortions arising from explicit and implicit fiscal operations often work in directions opposite to each other. Examples include:

- Uzbekistan, on the one hand, grants no value-added tax credit for the purchase of capital goods, adding 20 percent to their price; on the other hand, there is an implicit subsidy on imported capital goods of more than 50 percent (for centralized imports) and 40 percent (for other legal imports).
- Until July 2000, imports of sugar and vegetable oil were subsidized through the foreign exchange regime while at the same time both imports were taxed by regressive “import excises” of 20 percent.
- As shown above, there is a large implicit tax on centralized exports of more than 50 percent. At the same time, profits earned by exporting enterprises are taxed at half of the standard rate of 33 percent. In addition, exporters enjoy several other tax exemptions and implicit subsidies.
The consequences of reform in such situations are not clear a priori. Removing the smallest distortion while leaving the biggest in place would exacerbate, not improve, welfare losses. Removing the biggest while leaving the smallest in place would turn net taxation into net subsidization and vice versa, with an increase in welfare costs if the smallest price distortion was larger than half of the biggest. Therefore, it is essential for fiscal reform to identify distortions that work in opposite directions (like the examples above) and to abolish them simultaneously. Such reform packages would be superior to step-by-step reform or the elimination of the multiple exchange rate regime alone.

We conclude that the Uzbek authorities should reduce, if not eliminate, the above mentioned explicit and implicit distortions as soon and as simultaneously as possible.

APPENDIX
Calculation of the Net Welfare Loss Due to the Foreign Exchange Regime

The welfare loss (NWL) or excess burden due to Uzbekistan’s foreign exchange regime is derived in Rosenberg, Ruocco, and Wiegard (1999). Here we replicate only the case of implicit subsidies. Analogous manipulations apply for the case of implicit export taxes.

Let \( P_{MFT} \) denote the fixed world market price and \( M_{FT} \) be the import quantity that would result under free trade (FT). By sub we denote the ad valorem subsidy rate and by \( P_{Msu} = P_{MFT} (1 - \text{sub}) \) the subsidized price for Uzbekistan’s importers. \( M_{sub} \) is the corresponding import quantity under the subsidized exchange rate regime. Assuming a constant elasticity import demand function and using the concept of Harberger triangles from their graphical analysis, Rosenberg, Ruocco, and Wiegard (1999) show that for the small country case, the net welfare loss for Uzbekistan due to implicit import subsidies is

\[
\text{NWL}_M = \text{sub} P_{M_{FT}} M_{sub} - \left[ \alpha \frac{M_{FT}}{M_{sub}} dM - P_{M_{sub}} M_{sub} \right] - \left[ \alpha \frac{M_{FT}}{M_{sub}} dM - P_{M_{FT}} M_{FT} \right]
\]

\( \text{NWL}_M = \text{sub} P_{M_{FT}} M_{sub} - \frac{\alpha}{1 - \text{sub}} \left[ 1 - \left( \frac{M_{FT}}{M_{sub}} \right)^{\frac{1}{1 - \alpha}} \right]. \)  

From the import demand function (1) in the main text we obtain

\[
\frac{M_{FT}}{M_{sub}} = \left( \frac{P_{M_{FT}}}{P_{M_{sub}}} \right)^{\frac{1}{\alpha}} = \left( \frac{1}{1 - \text{sub}} \right)^{\frac{1}{\alpha}}. \]

Furthermore, we have

\[
AM_{sub}^{\alpha-\alpha} = P_{M_{sub}} M_{sub} = (1 - \text{sub}) P_{M_{FT}} M_{sub} = \frac{1 - \text{sub}}{\text{sub}} P_{M_{FT}} M_{sub}. \]

17 The welfare effects of such tradeoffs were, for example, calculated by Tarr (1990) for Poland in the late 1980s.
Inserting (ii) and (iii) into (i), and factoring out results in

$$
\frac{NWLM}{sub P^M_{FT} M_{sub}} = 1 - \frac{1}{1 - \alpha} \left[ 1 - \left( \frac{1}{1 - \alpha} \right)^{\alpha - 1} \right].
$$

(iv)

If $\alpha = 1$, the derivation is slightly different, but the outcome is basically the same. In this case the primitive function of $M^{-\alpha}$ is $M^{1-\alpha}(1-\alpha)$ but $\ln(M)$, so that $NWLM = sub P^M_{FT} M_{sub} + A (\ln M_{FT} - \ln M_{sub})$, or, for that matter, $sub P^M_{FT} M_{sub} + A \cdot \ln(M_{FT}/M_{sub})$.

If $\alpha = 1$, $A = (1 - sub) P^M_{FT} M_{sub}$, so that $NWLM = sub P^M_{FT} M_{sub} + A \cdot \ln(M_{FT}/M_{sub})$

$= sub P^M_{FT} M_{sub} + (1 - sub) P^M_{FT} M_{sub} \cdot \ln(M_{FT}/M_{sub})$

$= (using equation iv) sub P^M_{FT} M_{sub} + (1 - sub) \cdot P^M_{FT} M_{sub} \cdot \ln(1 - sub)$.

This means that

$$
NWLM / sub P^M_{FT} M_{sub} = [1 + (1 - sub) / sub] \ln(1 - sub).
$$

The net welfare losses in Table 5 (and, analogously, in Table 4) are calculated inserting alternative elasticity estimates and the implicit subsidy rates from Table 2. Table A1 shows the annual foreign exchange flows used in the calculations.

| Table A1. Uzbekistan: Annual Exchange Flows from Exports and Imports |
|--------|--------|--------|
|        | 1997   | 1998   | 1999   |
| **Exports** |        |        |        |
| Centralized     | 2,756  | 2,882  | 2,251  |
| Other           | 2,186  | 2,063  | 1,513  |
| **Imports**     |        |        |        |
| Centralized     | 3,926  | 2,872  | 2,251  |
| Other           | 2,941  | 1,597  | 905    |

Sources: CBU; and authors’ own calculations.
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Crash-Free Sequencing Strategies for Financial Development and Liberalization

JORGE A. CHAN-LAU and ZHAOHUI CHEN*

This paper uses a stylized model of financial intermediation to characterize the exact circumstances along various paths of economic growth, financial development, and liberalization that can trigger a financial crisis. It shows how to avoid financial crises through proper sequencing of various financial development and liberalization measures. The results of the paper show that naive combinations of financial development and liberalization processes can give rise to financial crises. In some typical situations, in order to avoid a financial crisis, it is important that financial liberalization be accompanied by financial development, in the form of improvements in the financial sector’s efficiencies. In the case of fast growing economies, financial development becomes even more imperative. [JEL E44, F3, G15]

The importance of financial liberalization and financial development in the process of economic growth was recognized early on by Goldsmith (1969), McKinnnon (1973), and Shaw (1973) among others. Well-developed financial

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systems perform a number of functions that influence the process of economic development. These functions include increased risk sharing, the facilitation of information acquisition and corporate control, the reduction of transaction costs, and the efficient allocation of savings among productive activities. In fact, a growing body of empirical studies has found a positive link between financial development and long-run economic growth.\(^1\) It is not surprising, then, that policies aiming to accelerate the pace of financial development and liberalization have gained acceptance in an increasing number of countries during the last few years.

However, the recent financial crises in Asia and Russia have led to a reexamination of and a heated debate about the wisdom of the process of financial development and liberalization, both in academic and policy making circles.\(^2\) At the academic level, it has been argued that increased globalization, and hence, financial liberalization, has made countries with sound economic policies vulnerable to financial crisis driven by a number of factors, including self-fulfilling expectations (Obstfeld, 1996), herd behavior by portfolio managers (Calvo and Mendoza, 2000), or the impossibility of smoothing out local liquidity shocks owing to the incompleteness of the structure of interregional claims (Allen and Gale, 2000), among others. At the policy making level, there is an ongoing debate on normative issues. On the one side is the camp that favors imposing controls and restrictions, on the other side is the camp that argues for more rapid and complete financial development and liberalization. On the former, Joseph Stiglitz vividly describes an emerging market as a small boat in the rough sea of international capital flows, where even a well-built boat can founder. On the latter, Lawrence Summers suggests that financial markets are like the airline industry: modern planes are stronger and larger, and make flying cheaper, faster, and safer. However, when disaster strikes, the negative consequences are magnified. The way out is not to ban airplanes or the financial markets, but to further improve the industry facilities.\(^3\)

Nevertheless, even those that consider that perfect and completely open financial markets are the ideal goal for most countries agree that openness cannot be achieved overnight.\(^4\) However, holding financial development in its infancy may not be the right solution: it may isolate the country from external financial shocks but it would deprive the country of the benefit of cheap international capital (and embedded technology). So the main task facing policy makers is a positive one: to find a path from an underdeveloped financial market to one of full and free participation in the international capital markets. The path can be risky, since the danger of a financial crisis may be looming menacingly along the transition. Nevertheless, countries must undergo the duress of the often troublesome “teenage” stage if they want to be part of the “adult” financial community. In this

\(^1\)Levine (1997) surveys the recent literature on financial development and economic growth.

\(^2\)An assessment of both the theoretical and practical aspects of capital account liberalization is presented in Eichengreen and others (1999).

\(^3\)The Economist, March 14, 1998.

\(^4\)See the article “Seminar discusses the orderly path to capital account liberalization,” IMF Survey, Vol. 27, Number 6, March 23, 1998.
"teenage" stage, proper policy sequencing is essential as expressed clearly in the April 1998 "Communique of the Interim Committee of the Board of Governors of the International Monetary Fund:"5

The financial crisis in Asia has given heightened attention to the role of capital flows in economic development. The effects of the crisis have not negated the contribution that capital movements have made to economic progress in the Asian countries before the crisis erupted. Rather, the crisis has underscored the importance of orderly and properly sequenced liberalization of capital movements [. . .]

Choosing a path that steers clear of the danger of a financial crisis is a two-step process. The first step is to identify the circumstances under which a financial crisis can occur. The second step is to formulate strategies that avoid such circumstances while moving towards the goals of financial development, liberalization, and economic growth. In other words, it is necessary to establish what preconditions must be satisfied before moving forward with financial development and the liberalization of the capital account. This paper presents a model that provides a simple analytical framework that helps us to identify the circumstances under which financial liberalization can be counterproductive by creating the necessary conditions for a financial crisis.6 In addition, the model provides an explanation to the puzzling observation that recent crises have affected fast growing countries that, prior to the crisis, enjoyed access to cheap international capital markets and were considered stellar performers. Do fast growth and easy access to international capital increase the risk of a financial crisis? Contrary to common perception, we find that the answer to the first question is positive most of the time. We also discuss how growing economies can avoid a financial crisis.

The results obtained in our stylized model require that we narrowly define the concepts of financial development and liberalization, that often have broad meanings in the literature.7 Financial development is defined as improvements in the efficiency of financial intermediation. It includes two aspects: (a) Improvements in financial infrastructure that lead to reduction in the sunk cost of financial intermediation. Examples may include physical completion of bank branches, computerization, deposit insurance, the establishment of proper accounting and disclosure rules and legal framework. (b) Improvements in the operating efficiency of the intermediaries—in other words, the reduction in marginal costs of financial intermediation. Examples may include the enhancement of credit analysis and risk management skills; reforms that eliminate crony capitalism, cozy but inefficient group cross holding, and improper government subsidies and intervention, and any other reductions in costs proportional to the amount of intermediation. Financial

6The advantage of this simplified framework is that the policy issues can be easily analyzed using a graphical approach. However, by emphasizing crisis-aversion as the overwhelming concern, the model cannot address the welfare costs and benefits associated with financial development and liberalization. The reader interested in these issues should refer to Caprio and others (1994).
7See Caprio and others (1994) and Dooley (1996).
liberalization is defined as the removal of controls to allow market determination of interest rates, and/or to allow competition. Typically, liberalization of interest rates in a regime of financial repression tends to lead to an initial rise in domestic interest rates, while an increase in competition—through free entry of domestic and foreign financial institutions—tends to lead to lower domestic interest rates. Capital account liberalization also leads to free capital flows that tend to equalize domestic and foreign interest rates.

I. The Model

Our analysis is an extension of the financial crisis and credit crunch model presented in Chan-Lau and Chen (forthcoming), to which we refer the reader for further technical details and assumptions.

There are three risk neutral agents in the economy: an entrepreneur (borrower), a depositor (foreign or domestic creditor), and a financial intermediary. We assume that the intermediary has limited monopolistic power so that it cannot fully pass the intermediation cost on to the entrepreneur when this cost is too high. This is the usual case in most of the developing countries where competition is limited and the government regulates the interest rate to some degree. It is assumed that all the agents are risk neutral.

The entrepreneur owns the rights to a risky project as well as an illiquid asset with terminal value \( E \). In our representative entrepreneur’s economy, \( E \) can also be interpreted as the market valuation of the fundamental strength of the economy, or the economy’s collateral value in the eyes of foreign creditors. To finance the project, the entrepreneur borrows from the intermediary at the gross rate \( 1 + i_L \). In case of success, the project’s return is enough to pay back the loan principal and the interest. Otherwise, it returns nothing and the illiquid asset is seized by the intermediary (up to the amount of the loan plus the loan interest) and transferred to the creditor (up to the amount of the deposit plus deposit interest). The probability of success of the project depends on the effort level of the entrepreneur. If the effort level is high the probability of success of the project is \( p_H \), otherwise it is equal to \( p_L \), with \( p_L < p_H \). The effort level depends on monitoring by the intermediary. If the intermediary monitors the loan, then the entrepreneur’s effort is high, otherwise it is low. Monitoring has a broad meaning, including project screening, auditing, on-site inspection, and other corporate governance mechanisms and is costly.

The financial intermediary borrows an amount \( D \) from the depositors at the gross rate \( 1 + i_B \), and lends it to the entrepreneur. Its payoff is given by:

\[
\min\{D(1 + i_L), E\}
\]

In case that \( E > D(1 + i_B) \), the intermediary can pay back the principal and interests. Otherwise, it transfers the collateral \( E \) to the depositor. Thus, in our setup, the intermediary is a limited liability institution.
The depositor can also invest in a safe asset and earn a risk-free rate of return, \(i_f\). Because the depositor must earn at least the risk-free rate, the amount of credit he is willing to supply to the intermediary is given by:

\[
D_m(E) = \frac{(1 - p_H)E}{1 + i_f - p_H(1 + i_B)},
\]

(1)

\[
D_u(E) = \frac{(1 - p_L)E}{1 + i_f - p_L(1 + i_B)},
\]

(2)

where the subscripts \(m\) and \(u\) denote that monitoring is performed or not performed, respectively. The amount of intermediation under monitoring is greater than that without monitoring, and they are both increasing in the borrowing rate \(i_B\) and decreasing in the risk-free rate.\(^8\)

Monitoring loans is an activity that involves both fixed and variable costs. In our model, the costs represent the extent of the inefficiency in financial intermediation. Fixed costs include sunk costs, overhead costs, salary and wage costs, expenses in branch facilities and equipment (computers), which are typical of banking institutions, as well as costs resulting from the legal and supervisory environment, such as bankruptcy enforcement costs. Variable costs include operating and administrative costs, as well as regulatory costs resulting from mandatory reserve ratios, etc. In different country environments, these costs take different forms.\(^9\) Arguably, substantial investment in banking infrastructure in many emerging markets has made fixed costs relatively low, but operating efficiency has lagged far behind owing to inadequate staff training, obscure accounting systems, and lack of disclosure and competition. Banking costs, both fixed and variable costs, are higher in emerging market countries than in developed countries.\(^10\)

Technically, we represent these costs by the following simple cost function:

\[
C(D) = \begin{cases} 
\phi & \text{if } D < D_\phi = E/(1 + i_L) + E_v, E_v \text{ constant} \\
\phi + \beta(D - D_\phi) & \text{if } D > D_\phi 
\end{cases}
\]

The cost is a function of the size of the loan, \(D\), the entrepreneur’s asset \(E\), and the efficiency of the monitoring technology, which is measured by the parameter \(\beta > 0\) and by a fixed cost \(\phi > 0\) and reflect the efficiency of the intermediary. The intermediary can monitor projects requiring a loan size less than \(D_\phi\) by paying a fixed cost of \(\phi\). The depositor can observe whether the intermediary monitors or does

\(^8\)For details on the derivation of these equations, see Chan-Lau and Chen (forthcoming).

\(^9\)For example, in South Korea the cozy relationship between banks and chaebols implies a potentially low fixed cost of monitoring because they know each other well. However, the cost of disclosing and acting on the information gathered is potentially costly.

\(^10\)See Barajas, Steiner, and Salazar (1999) for details.
Jorge A. Chan-Lau and Zhaohui Chen

not monitor the entrepreneur, which makes the probability of success of the project known to all agents. There is no asymmetric information.

We focus on the case in which the amount of intermediation (or loan size) plus interest exceeds the value of the collateral, that is, $D_m(1+i_B) > E$, which holds when $E_0/E > \Delta i/(1 + i_B)(1 + i_L)$. In this case, the expected profit of the intermediary is given by:

$$E\Pi^m(D) = p_H \Delta i D - \max\left\{0, 0 + B(D - D_0)\right\}. \quad (3)$$

Similarly, when the intermediary does not monitor, its expected profit is given by:

$$E\Pi^u(D) = p_L \Delta i D. \quad (4)$$

Monitoring takes place only when it generates more profits than without monitoring:

$$\Delta E\Pi(D) = E\Pi^m(D) - E\Pi^u(D) = \Delta p \Delta i D - \max\left\{0, 0 + B(D - D_0)\right\} > 0 \quad (5)$$

The amount of the loan offered to the entrepreneur by the intermediary as well as the decision to monitor or not depend on: (a) the efficiency of the intermediary, as measured by its monitoring costs, (b) the interest rate differential, $\Delta i = i_L - i_B$, (c) the credit supply by the depositors, as defined by equations (1)-(2), and (d) the terminal value of the existing asset $E$. There exist six possible cases, which can be classified according to the magnitude of various monitoring costs relative to the interest rate differential and the value of the illiquid asset:11

<table>
<thead>
<tr>
<th>Case</th>
<th>$\phi$</th>
<th>$\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$\Delta p \Delta i \left(\frac{E}{1 + i_L} + E_0\right)$</td>
<td>$p_H \Delta i$</td>
</tr>
<tr>
<td>2</td>
<td>$\Delta p \Delta i \left(\frac{E}{1 + i_L} + E_0\right)$</td>
<td>$p_H \Delta i$</td>
</tr>
<tr>
<td>3</td>
<td>$\Delta p \Delta i &lt; \beta &lt; p_H \Delta i$</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>$\Delta p \Delta i &lt; \beta &lt; p_H \Delta i$</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>$\Delta p \Delta i &lt; \beta &lt; p_H \Delta i$</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>$\Delta p \Delta i &lt; \beta &lt; p_H \Delta i$</td>
<td></td>
</tr>
</tbody>
</table>

11These cases and their corresponding choice of monitoring action and deposit demand by the intermediary are analyzed in detail in the appendix.
In Case 1 the economy is vulnerable to the risk of financial crisis or crash, which is defined as the sudden discrete reversal of capital inflows into the banking system, a phenomenon that resembles a credit crunch. Formally, this crisis-prone equilibrium can be defined as one in which there is an insufficient demand for credit by the intermediary. A formal definition of this and other equilibria is presented in the appendix. It is easy to describe the crisis-prone equilibrium using Figure 1. The thick lines represent the expected profit to the financial intermediary, with a local maximum at the point $D_0$, which is the optimal amount of intermediation with monitoring. $D_u$ is the maximum supply of credit by the depositor and depends positively upon a measure of the fundamental strength of the economy $E$. An important feature of this model is that a small change in credit supply can trigger a large capital outflow and/or credit crunch. From Figure 1, we can see that the amount of equilibrium intermediation (when demand for credit equals credit supply) can increase, unmonitored, after the switching point $D_s$. When credit supply is between $D_0$ and $D_s$, however, there is no demand by the intermediary because its expected profit is below the local maximum, so the intermediary borrows only $D_0$. So even when $D_u$ declines to a level marginally below $D_s$, the size of capital outflow is as large as $D_s - D_0$.

In this work, we are more concerned about the process of financial development, financial liberalization, and economic growth, so the economy would be able to switch from one case to another as the interest rate differential, the costs parameters, and fundamental strength change. In our simplified setup, the narrowing of the interest rate differential results from the process of financial liberalization while the reduction of the monitoring costs are the consequence of
the financial reform process. It is of special interest to pinpoint the conditions under which either financial development and liberalization or both processes can put the economy at risk by shifting it to Case 1.

The analysis is greatly simplified if the six different cases are graphed in a three-dimensional space, where the orthogonal axes correspond to the sunk cost, $\phi$, the marginal cost, $\beta$, and the interest rate differential, $\Delta i = i_L - i_B$. The boundaries among the different cases are determined by the following surfaces:

\[ S_1: \phi = \Delta p \Delta D_0 \]
\[ S_2: \beta = \Delta p \Delta i \]
\[ S_3: \beta = p_H \Delta i, \]

which are depicted in Figures 2 and 3. For expositional purposes, we will refer to the region corresponding to Case 1 as Region 1, Case 2 as Region 2, and so on. In particular, Region 1 will be referred to as the crisis-prone region. Figure 2 shows the case in which the deposit rate $i_B$ is fixed and changes in the interest rate differential correspond to changes in the lending rate $i_L$. In this case, $S_1$ is a nonlinear surface because $\Delta D_0$ is a nonlinear function of $i_L$. In Figure 3, the lending rate $i_L$ is fixed and we let the deposit rate $i_B$ vary. In this case, $S_1$ is a linear function of the interest rate differential $\Delta i$. For convenience, we choose to use the interest rate differential $\Delta i$ as one of the axes instead of $i_L$ in Figure 2, and instead of $i_B$ in Figure 3. Our graphical framework does not preclude the analysis of simultaneous changes in $i_L$ and $i_B$; first, we use Figure 2 to analyze a change in $i_L$ keeping $i_B$ fixed and afterwards, change $i_B$ while keeping $i_L$ constant at its new level.

In addition, the level of financial development in the economy at any point can be represented by the ordered pair $(\phi, \beta)$ in the $\phi - \beta$ plane. Therefore, we can represent any economy by the ordered set $(\phi, \beta, \Delta i)$, which grossly represent the degrees of financial development and financial liberalization.

II. Financial Liberalization Unaccompanied by Financial Development

Consider a case of financial liberalization as characterized by a decrease in $\Delta i$ due to a decrease in the lending rate, $i_L$. This decrease in the interest rate differential can be interpreted as a result of increasing competition in the banking sector, which erodes the monopolistic power of the domestic banking sector, or the reduction of capital account restrictions. Assuming that the borrowing rate is constant (as in the case of a small country’s international borrowing), we can restrict our analysis to the situation depicted in Figure 2. If the economy is either in Region 3 or Region 5, a decrease in $\Delta i$ may lead the economy to Region 1 for

---

12As noted earlier, liberalization of interest rates in a regime of financial repression tends to lead to an initial rise in domestic interest rates, hence the widening of the interest rate differential, whose effect can be analyzed in the model.
Figure 2. Possible States of the Economy (constant deposit rate)

Figure 3. Possible States of the Economy (constant lending rate)
certain levels of financial development, represented as different combinations of sunk and variable costs \((\phi, \beta)\). For example, in Figure 4, financial liberalization moves the economy from point A to point B, the latter inside the crisis-prone region. Thus, financial liberalization can move an economy to a situation in which it would be vulnerable to a financial crisis. The wider the range of pairs \((\phi, \beta)\), the more vulnerable an economy is, since it increases the likelihood that financial liberalization can put it at risk if financial development does not complement the former process.

It is possible to characterize precisely the combination of fixed and marginal costs \((\phi, \beta)\) (or levels of financial development) such that financial liberalization may increase the vulnerability of the economy to a financial crisis or domestic crunch. It is simply the area in the \(\phi - \beta\) plane that lies between the \(\beta\) axis and the projection in the \(\phi - \beta\) plane of the intersection between the surfaces \(S_1\) and \(S_3\). We can define the *vulnerability region* as the level of financial development, represented by the pairs \((\phi, \beta)\), such that a large enough decrease in the interest differential can move the economy to the crisis-prone region. Strictly speaking, the *vulnerability region*, denoted by \(A_1\), can be represented as:

\[
A_1 = \left\{ (\phi, \beta) : \phi < \frac{\beta \Delta p}{p_H} \left( \frac{p_H E}{1 + \beta + p_H i_B + E_0} \right) \right\}
\]

which is the shaded region depicted in Figure 5.
III. Financial Development Unaccompanied by Financial Liberalization

Under the assumption that there is no financial liberalization, and the deposit interest rate remains fixed, $\Delta i$ is constant and we can analyze the process of financial development in the $\phi - \beta$ plane, which simplifies the analysis greatly. Without loss of generality, for a given interest rate differential, the analysis is reduced to the projection of the six regions in the $\phi - \beta$ plane, as represented as in Figure 6. Notice that only the economies in Region 2 are at risk of being vulnerable to financial crisis if the process of financial development reduces the sunk cost $\phi$ faster than the variable cost $\beta$, because the economy may move from Region 2 to Region 1 as a result. Therefore, financial development must decrease the marginal operating cost faster than the fixed cost. In fact, without knowing with certainty in which region the economy is located, the safest strategy is to reduce the variable cost first, say until it is below $\Delta \rho \Delta i$, and then to proceed to reduce the fixed cost $\phi$. In the operational sense, this suggests that reform measures should first focus on enhancing the credit analysis and monitoring expertise and operating efficiencies of the intermediaries, rather than improving the banking infrastructure that relates only to the fixed cost aspects of financial intermediation.

Technically, if the initial position of the economy is in Region 2 and known with certainty, say, at $(\phi_0, \beta_0)$, any proper sequencing of financial reform that avoids leading the economy to Region 1 must be such that the speed of fixed and marginal cost reduction, $\partial \phi/\partial t$ and $\partial \beta/\partial t$ respectively, satisfy the following inequality:
Of course, if the initial position is outside both Region 1 and Region 2, then any sequencing of financial development is fine, without the danger of a financial crisis.

To summarize, in the absence of financial liberalization, the choice of sequencing is reduced to the relative speed of financial developments in the two fronts: one that reduces the fixed costs of intermediation, the other that reduces the marginal costs of intermediation. When the current efficiency position is in doubt, it is always safer to embark on operating efficiencies first.

IV. Financial Development and Liberalization

The proper sequencing of financial development and liberalization must be such that the trajectory of the economy avoids the crisis-prone region depicted in Figures 2 and 3. Because there exist many different trajectories corresponding to different financial development and liberalization measures such that the crisis-prone region can be avoided, policy makers have many degrees of freedom to choose the one that minimizes their cost-benefit trade-off, according to their own policy goals. As an example, suppose that the sunk cost, $\phi$, is fixed and the economy is originally located in point A, as shown in Figure 7.
If the desired goals of liberalization and reform must be such that the final position of the economy is at point $D$, there are many ways to achieve this objective. One of them is to start the financial development process first while delaying financial liberalization until the reform objectives have been achieved. This is illustrated by the trajectory $ABD$. Another way to proceed is to start both financial development and liberalization simultaneously, such that the speed of financial development is faster than the speed of liberalization, that is, the slope of the segment $AC$ is flatter than that of the segment $AE$. Once the economy has reached point $D$, it is safe to start reducing the fixed cost component.

In general, when the policy maker is uncertain about the economy’s current position, the safest way to proceed is to develop the financial sector first and then to undertake financial liberalization. Financial development should start by decreasing the marginal cost component of the financial intermediation sector, and then proceed to reduce the fixed cost component. We must keep in mind, though, that the sequencing described does not guarantee a crash-free evolution, since the economy is still subject to deposit rate shocks and shocks to the fundamental strengths of the economy. The effects of these shocks are discussed in the following two sections.

V. Shocks to the Deposit Rate $i_B$

Consider the case of financing by foreign deposits. Assuming that all the other variables remain constant, shocks to the world interest rate, $i_B$, can be interpreted as changes in the interest rate differential, $\Delta i$. The analysis then is analogous to the
case where financial liberalization precedes financial development, with the vulnerability region, $A_1$, redefined as:

$$
A_1 = \left\{ (\phi, \beta) : \phi < \frac{\beta \Delta p}{p_H} \left( \frac{E}{1 + i_L} + E_p \right) \right\}
$$

Referring to Figure 3, an increase in the deposit rate, $i_B$, keeping $i_L$ constant, is equivalent to a narrowing of the interest rate differential, $\Delta i$, and for some economies lying in Regions 3 and 5, it can move them to Region 1, depending on whether their level of financial development, represented by their ordered pairs $(\phi, \beta)$, lies in the vulnerability region defined in equation (8).

As in the previous case, an increase in the market valuation of a country’s economic strength, $E$, increases the extent of the vulnerability region, $A_1$. In contrast, an increase in the domestic lending rate, $i_L$, reduces the region $A_1$ and therefore, reduces vulnerability to a crisis, other things being equal.

VI. Economic Growth and Financial Crisis

To answer the question why high-growth countries are not immune to financial crisis, we first examine the case of financial liberalization unaccompanied by financial development. In our model, a fast growing economy is characterized by a fast growing value of $E$. Recall the definition for the crisis-prone region, reproduced below for easy reference:

$$
A_1 = \left\{ (\phi, \beta) : \phi < \frac{\beta \Delta p}{p_H} \left( \frac{p_HE}{1 + \beta + p_H i_B} + E_p \right) \right\}
$$

Clearly, the extent of region $A_1$ depends on the market valuation of the fundamental strength of the economy, $E$. An increase in $E$ enlarges the region $A_1$ and hence, increases the vulnerability to a financial crisis under financial liberalization. Furthermore, typically, a fast growing economy will be characterized by a high value of $E$ and cheaper access to the world capital markets, which implies a lower borrowing rate $i_B$. The combination of these two factors can increase the vulnerability of a country to a crisis if financial development does not take place.

When economic growth, financial development, and financial liberalization proceed simultaneously, the interaction becomes very complex, and the right sequencing of financial development and liberalization must be designed such that financial crises are avoided.

Figure 8 shows the effects of an increase in $E$. This increase shifts up the surface $S_1$, increasing the size of Regions 1, 3, and 5. Thus, economic growth can put at risk economies that were previously in a safe region, such as those that were originally situated in Region 2 but that now lie in Region 1 as a result of the increase in $E$. For example, economies previously located in subregion $A$ are now in the crisis-prone region after an increase in $E$. In consequence, financial devel-
opment is an even more urgent task in fast growing economies and should not be put off for any reason: for any fixed combination of \((\phi, \beta)\), fast growth would keep increasing the market valuation \(E\) until the economy is swallowed by the ever-enlarging crisis-prone region. Thus, if a country starts liberalizing its financial sector during a period of rapid growth, it must undertake rigorous structural reforms of its financial sector first or at least at a faster pace than the liberalization process.

VII. Concluding Remarks

This paper has developed a model of financial intermediation that offers some interesting insights into the interaction among economic growth, financial development, financial liberalization, and the occurrence of financial crisis. By identifying basic stylized inefficiencies of the financial sector, it is possible to derive simple graphical tools that enhance our understanding about how naive combinations of financial development and liberalization can give rise to a financial crisis. In particular, in the case of fast growing economies, financial development aimed at improving the efficiencies of the financial sector becomes even more imperative.

The analysis also highlights the fact that there are many different ways to conduct an orderly sequencing of financial development and liberalization, such that crises can be avoided. The preferred sequencing process would depend on the objective functions of the policy makers, the set of economic and political constraints they face, and the costs and benefits associated with each sequence of measures. We consider that the determination of the optimal sequencing path
requires the incorporation of these elements in the model and offers an interesting research area.

Finally, it is widely believed that a decrease in the cost of borrowing abroad, and an improving economic performance reflected in higher rates of growth and in higher market valuation of a country’s assets by international investors, are good for emerging economies. Moreover, rapid growth rates usually reduce the borrowing costs faced by a country in the world markets, triggering bullish expectations. The availability of cheap foreign capital and a growing economy can effectively disguise the weakness of the financial sector, and get the financial liberalization process started, amidst the generalized optimistic environment. However, the combination of these two factors increases the country’s vulnerability to a financial crisis. If financial development lags behind, the country is flirting with disaster. The experience in Asia and Latin America as well as empirical studies support this theoretical finding.\(^\text{13}\)

APPENDIX

This appendix defines the equilibrium in the domestic credit market rigorously. Let’s denote the set of monitoring actions \(A\) available to the intermediary by \([M, N]\), where \(M\) stands for monitoring the entrepreneur, and \(N\) stands for not monitoring the entrepreneur.

Given the parameters \([\phi, \beta, i_B, i_L, p_H, p_L]\), a **domestic equilibrium with intermediation** is given by the choice of a monitoring action \(A \in [M, N]\) by the intermediary, and its demand for deposits \(D\) (equal to the supply of loans to the entrepreneur) such that: (E1) \(D \leq D_A\), where the maximum amount supplied by depositors, \(D_A\), is given by equations (1) and (2) when \(A = M, N\) respectively, and (E2) \(A\) and \(D\) maximize the intermediary’s expected profits, which is given by equations (3) and (4) when \(A = M, N\) respectively.

The following assumptions are sufficient to ensure that the upper bounds on deposits, given by equations (1) and (2), are positive, to guarantee the existence of a domestic equilibrium with intermediation, and that the demand for deposits is always greater than the maximum fully collateralized debt that the entrepreneur can afford, \(E(1 + i_L)\):

(A1) The intermediary’s borrowing rate is at least equal to the risk-free rate, e.g., \(i_B \geq i_P\).

(A2) \(p_H(1 + i_B) < 1 + i_L\).

(A3) \(p_L(1 + i_L) > 1 + i_B\).

(A4) After paying a fixed cost \(\phi\), the intermediary can monitor loan sizes less or equal to \(D_B = E(1 + i_L) + E_p, E_B\) constant.

In order to understand the concept of a crash in this economy, it is useful to interpret the equilibrium as a mapping from the amount supplied by depositors into the monitoring decision and demand for deposits of the intermediary. Thus, we can define a **crash-prone or crisis-prone** equilibrium as a discontinuous mapping from the amount supplied by depositors into the demand for deposits. Clearly, this definition implies that the demand for deposits is strictly less than the maximum amount that depositors can supply given a monitoring action by the intermediary, e.g. \(D < D_A\). This definition captures two important characteristics of a crisis. First, there is a credit crunch in the sense that the total supply of loans in the domestic economy falls short from the maximum available supply of deposits. Second, the existence of a discontinuous mapping implies that small changes in a number of the parameters of the economy can lead to a large change in the domestic supply of loans.

\(^{13}\)See Demirguc-Kunt and Detragiache (1998).
It can be verified that the \{A, D\} equilibrium can be one of the following six cases:

**Case 1 (Crisis-Prone Equilibrium):** If \( \phi \leq \Delta p \Delta i D_0 \) and \( \beta \geq p_H \Delta i \), there exists a crisis-prone equilibrium, and the equilibrium is characterized by:

a) \( \{N, \bar{D}_0(E)\} \) if \( \bar{D}_0(E) < D_m \), where \( D_m \) satisfies \( E IT^M(D_m) = E IT^M(D_0) \).

b) \( \{M, \min(D_m(E), D_u)\} \) if \( D_m(E) \geq D_u \) and \( D_m(E) < D_u \), where \( D_u \) satisfies \( E IT^M(D_u) = E IT^M(D_0) \).

c) \( \{N, \bar{D}_0(E)\} \) if \( \bar{D}_0(E) \geq D_u \).

In this case, there is no intermediation in the interval \( (D_0, D_u) \).

**Case 2:** If \( \phi \geq \Delta p \Delta i D_0 \) and \( \beta \geq p_H \Delta i \), the equilibrium is \( \{N, \bar{D}_0(E)\} \).

**Case 3:** If \( \phi \leq \Delta p \Delta i D_0 \) and \( \Delta p \Delta i \leq \beta \leq p_H \Delta i \) the equilibrium is given by:

a) \( \{N, \bar{D}_0(E)\} \) if \( \bar{D}_0(E) \leq D_m \), where \( D_m \) is the only solution to \( E IT^M(D) = E IT^M(D_0) \) in the interval \( [E/(1 + i_0), D_0] \).

b) \( \{M, \bar{D}_0(E)\} \) if \( D_m \leq \bar{D}_0(E) \leq D_m \) and \( \bar{D}_0(E) < D_m \), where \( D_m \) was defined above and \( D_m \) is the only solution to \( E IT^M(D) = E IT^M(D_0) \) in the interval \( [D_0, \infty] \).

c) \( \{N, \bar{D}_0(E)\} \) if \( \bar{D}_0(E) > D_m \).

**Case 4:** If \( \phi \geq \Delta p \Delta i D_0 \) and \( \beta \leq p_H \Delta i \), the equilibrium is \( \{N, \bar{D}_0(E)\} \).

**Case 5:** If \( \phi \leq \Delta p \Delta i D_0 \) and \( \beta \leq p_H \Delta i \), the equilibrium is given by \( \{N, \bar{D}_0(E)\} \) if \( \bar{D}_0(E) \leq D_m \), where \( D_m \) was defined above. Otherwise the equilibrium is given by \( \{M, \bar{D}_0(E)\} \).

**Case 6:** If \( \phi \geq \Delta p \Delta i D_0 \) and \( \beta \geq p_H \Delta i \), the equilibrium is given by \( \{N, \bar{D}_0(E)\} \) if \( \bar{D}_0(E) \leq D_m \). Otherwise, the equilibrium is given by \( \{M, \bar{D}_0(E)\} \).

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Dynamic Gains from Trade: Evidence from South Africa

GUNNAR JONSSON AND ARVIND SUBRAMANIAN

This paper examines the empirical relationship between trade and total factor productivity (TFP) in South Africa. Using data on actual trade protection across different manufacturing sectors, it is shown that trade liberalization had a positive impact on TFP growth during the 1990s. In addition, time-series evidence on macro data supports a positive long-run relationship between TFP and openness. [JEL F14, F43, O40]

The pendulum of academic research on the positive relationship between trade and economic growth appears to be swinging from near universal to more qualified acceptance.1 The spate of cross-country empirical evidence—marshaled by Dollar (1992), Sachs and Warner (1995), and Edwards (1998)—that asserts the positive impact of trade on economic growth has recently been questioned, most notably by Rodriguez and Rodrik (1999). While not arguing for the converse proposition, namely, that trade has a negative impact on growth, they assert that earlier authors did not consistently and reliably (in a statistical sense) demonstrate the regularity in the observed data. A reading of the literature yields the impression that the recent skepticism is an outgrowth of a more generalized dissatisfaction with the cross-

1Throughout this paper, the term “trade” will encompass two distinct concepts: the first, trade liberalization, will denote explicitly the reduction of domestic trade policy barriers, while the second, openness, will refer to trade outcomes.

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country approach per se (see, e.g., Srinivasan, 1997), which therefore argues for a research strategy that focuses on exploring more contingent or situation-specific relationships. This paper attempts to do this for the particular case of South Africa.

More specifically, this paper examines the empirical relationship between trade and total factor productivity (TFP) in South Africa, where the hypothesis is that enhanced trade in recent years has improved efficiency in the South African economy. The study would be important from a policy perspective, as trade liberalization constitutes an important element in the government’s efforts to boost the underlying supply capacity of the economy. But in light of the ambiguity of the empirical results described above, it would also be interesting from a research perspective to see whether and how the South African experience differs from that of other countries.

Moreover, South Africa affords the possibility of an interesting case study on account of a rich variation in trade policy orientation and productivity performance across the manufacturing sectors and to a similar rich variation in degree of openness over time owing both to external sanctions and trade liberalization. The availability of disaggregated data—on capital stock, employment, and trade policy—also permits such questions to be examined. Thus, a distinctive feature of the paper is that the issue of trade and TFP growth is examined from both a cross-section and a time-series perspective.

I. Previous Research

In theoretical models, the impact of trade liberalization on economic growth is either absent or ambiguous. In a conventional neoclassical growth model, trade does not affect the equilibrium or steady-state rate of output growth because, by assumption, growth is determined by an exogenously given technological progress. In two-sector models of this kind, trade policy affects the allocation of resources between sectors and, hence, the steady-state level of savings and capital accumulation. This can have a one-off effect on the steady-state level of output (which can be positive or negative depending on how savings and capital accumulation are affected by trade policy) but not on the rate of growth. Nevertheless, even in the neoclassical model, trade policy can have transitional growth effects as the economy converges toward the steady state.

However, in endogenous growth models, the impact of trade liberalization on output growth can be positive or negative, depending on model-specific assumptions. Increased trade can have a number of generalized positive impacts. For example, trade enables a country (i) to employ a larger variety of intermediate

2In static models without market imperfections (such as monopolistic market structures, internal and external economies of scale, or other distortions), trade restrictions reduce the level of real GDP (equivalent to welfare when measured at world prices). The presence of imperfections opens up a plethora of possibilities in which the effects of trade policies are typically indeterminate, depending on the prior distortion (see Bhagwati, 1971).

3The distinction between the transitional path and the steady state is well-defined in theory, but less easily applied empirically. If transitions are sufficiently long, the actual data could exhibit growth effects from trade policy changes.

4See, for example, Grossman and Helpman (1991), and the references therein.
goods and capital equipment which could enhance the productivity of its other resources; (ii) to acquire technology developed worldwide, especially in the form of embodied capital goods; (iii) to increase the variety of products produced and consumed; and (iv) to improve the efficiency with which resources are used, which can help to change market structures and reduce markups, thereby imparting dynamic efficiency benefits (Levinsohn, 1992). However, the impact of trade policy changes cannot be unambiguously signed. If the resource allocation effects of trade policy changes promote sectors or activities that generate more long-run growth, the impact is positive, and negative otherwise. The question, then, is really an empirical one of determining the impact of trade policy in specific cases.

The empirical evidence on trade and economic growth has two distinct strands. The first and perhaps the largest is based on cross-country studies—see, for example, Dollar (1992), Sachs and Warner (1995), Ben-David (1993), Edwards (1998), and Coe, Helpman, and Hoffmaister (1997). This literature has focused either on the direct impact of trade on growth in output (the first three studies) or in TFP (the last two studies). While all of these studies reach the broad conclusion that increased trade has a positive impact on growth, they have now been critically reviewed by Rodriguez and Rodrik (1999) and Rodrik (1999), who call their results into question.

The critique can be thought of as comprising the following elements: first, that the really meaningful question to ask is not whether openness, defined in terms of outcomes, helps growth but whether more liberal trade policy helps growth. In this view, the trade outcome approach suffers from conceptual and empirical shortcomings, including the endogeneity of outcomes, the failure to specify the mechanism through which exports and imports affect growth, and measurement problems. Second, that recent prominent studies do not incontrovertibly support the positive relationship between trade policy and growth either because they mismeasure trade policy (Dollar, 1992), or that the trade policy variable they employ is actually picking up other effects such as macroeconomic stability or regional dummies (Sachs and Warner, 1995), or because their results are not robust to alternative specifications (Edwards, 1998).

The second strand in the empirical literature comprises intra-country studies based either on plant-level data or industry-level data. Although it is difficult to summarize the results of this strand of literature, it indicates that the causal link between trade and total factor productivity is less evident in the data. For example, Harrison (1994) finds that, while TFP growth and trade policy orientation do not appear to be correlated at the industry level, a correlation can be detected when TFP is measured appropriately by taking into account the biases emanating from the presence of nonconstant returns to scale and imperfect competition. Bernard and Jensen (1999) suggest that while efficiency and trade orientation are correlated, the causation appears to run from the former to the latter in the sense that efficient firms tend to self-select into export markets rather than openness leading to increased efficiency. Finally, one of the few papers that examines the empirical

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6See, for example, Tybout (1992), Bernard and Jensen (1999), and Harrison (1994).
relationship between trade and growth from a time-series perspective is Coe and Moghadam (1993) for the case of France. They find a robust long-run relationship among growth, factor inputs, and openness (which is intended to capture the effects of total factor productivity).

II. Trade Policy and Trade Developments in South Africa

Trade Policy Prior to the 1990s

Trade policy, or rather, trade protection has played an important role not only in South Africa’s economy but also in the country’s politics. The appeal of economic self-sufficiency—that pervaded the developing world during the 1960s and 1970s—was heightened in the case of South Africa by political imperatives. Self-sufficiency was seen as a necessary precautionary response to an “inimical” external world that could—and eventually did—cut off supplies to the country.

During the 1960s and 1970s, South Africa’s trade regime was characterized by high tariffs and extensive import controls, including through formal import quotas. In response to the perception that growth through import substitution was being exhausted and in the wake of declining manufacturing production and trade, attempts were made to mitigate the anti-export bias of the system. Formal import quotas gave way to import licensing, but the focus, however, was on export promotion measures. Beginning in 1983, the first systematic attempt was made to eliminate import licensing which then covered 77 percent of imports. In 1985, South Africa switched from a positive list of permitted imports (i.e., imports not subject to licensing) to a negative list of prohibited imports covering about 23 percent of imports so that more than three quarters of imports were exempt from licensing (see GATT, 1993).

However, with the imposition of financial sanctions and the debt standstill in 1985, balance of payments pressures halted, and even reversed, progress on trade liberalization. An import surcharge of 10 percent was introduced in 1985, which was increased to 60 percent on some items in 1988, and by 1990 there were three rates (10 percent, 15 percent, and 40 percent) for the surcharge. During the 1980s, a number of export schemes were introduced to alleviate the burden on exporters. In 1990, these were consolidated into one scheme—the Generalized Export Incentive Scheme (GEIS)—that provided a tax-free subsidy to exporters related to the value of exports, the degree of processing of the exported product, the extent of local content embodied in exports, and the degree of overvaluation of the exchange rate.

By 1992, only 15 percent of tariff lines in the manufacturing sector were subject to import licensing which had become virtually automatic and hence less restrictive. Only agriculture (74 percent of tariff lines) and five manufacturing sectors—food, beverages, rubber, and tobacco (about 90 percent) and clothing (59 percent)—remained subject to licensing (GATT, 1993). The tariff regime was highly complex. By the end of the 1980s, South Africa had the most tariff lines (greater than 13,000), most tariff rates (200 ad valorem equivalent
rates), the widest range of tariffs, and the second highest level of dispersion (as measured by the coefficient of variation) among developing countries (see Belli, Finger, and Ballivian, 1993). In sum, South Africa had a highly distorted system of protection (see Table 1).

Trade Policy in the 1990s

The impetus for liberalization started gaining momentum in the early 1990s, reflected in a consultative process under the auspices of the tripartite National Economic Forum involving government, labor, and organized business. As a result, South Africa adopted a two-pronged approach to trade liberalization during the 1990s. These included (i) unilateral trade liberalization and (ii) multilateral trade liberalization in the context of the Uruguay Round of trade negotiations.

Unilateral trade liberalization, 1990-94

Between 1990 and 1994, trade liberalization largely took the form of eliminating the remaining import licensing procedures that were in place and reducing import tariffs. The average tariff was reduced from 28 percent to 16 percent while the import surcharge was eliminated. Thus, the sum of all charges on imports was reduced from 34 percent to 16 percent.

Unilateral trade liberalization, 1994-98

South Africa announced, in 1994, a schedule of unilateral tariff liberalization expiring in 1999 that went beyond the Uruguay Round commitments. As a result, its average (import-weighted) tariffs in manufacturing declined from 16 percent in 1994 to 10 percent in 1998. The current average (import-weighted) tariff is below the level committed by South Africa in the WTO by more than 5 percentage points, although the “water in the tariff” varies considerably between sectors.

As a result of these changes, South Africa’s trade regime has been considerably liberalized since the early 1990s. Virtually all quantitative restrictions have been eliminated, including those operating through agricultural marketing boards; the tariff regime has been rationalized, with the number of lines having been reduced from over 13,000 in 1990 to about 7,900 in 1998 and the number of tariff bands having been reduced from well over 200 to 72. In addition, the tariff regime was simplified, as the number of lines carrying formula duties (which acted like variable import levies) was reduced from 1,900 in 1993 to 28 in 1997, and the number of lines facing specific tariffs was reduced from 500 to 227, respectively.

Multilateral trade liberalization, 1995-2002

In the context of the Uruguay Round, South Africa made a tariff offer phased over five years that took effect on January 1, 1995 (except in the case of three sectors

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7The average bound tariff in the WTO in 2004 will be about 16 percent.
Table 1. South Africa: Trade Regime, 1990 and 1998
(In percent, unless otherwise indicated)

<table>
<thead>
<tr>
<th></th>
<th>1990</th>
<th>1998</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tariffs</strong></td>
<td></td>
<td></td>
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<tr>
<td>Manufacturing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum tariff</td>
<td>1,389</td>
<td>72</td>
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<tr>
<td>Average import-weighted tariff</td>
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<td>10</td>
</tr>
<tr>
<td>Average unweighted tariff</td>
<td>30</td>
<td>14</td>
</tr>
<tr>
<td>Number of tariff bands</td>
<td>&gt; 200</td>
<td>72</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>43</td>
<td>15</td>
</tr>
<tr>
<td>Number of tariff lines</td>
<td>&gt;13,000</td>
<td>7,814</td>
</tr>
<tr>
<td>Percent of tariff lines with non-ad valorem duties</td>
<td>28</td>
<td>26</td>
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<tr>
<td>Range of effective protection</td>
<td>189 to -411</td>
<td>204 to -2</td>
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<tr>
<td>Average import-weighted surcharge</td>
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</tr>
<tr>
<td>Import surcharge bands</td>
<td>10, 15, and 40</td>
<td>Eliminated</td>
</tr>
<tr>
<td>Agriculture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average tariff</td>
<td>25</td>
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<tr>
<td>Average import surcharge</td>
<td>8</td>
<td>0</td>
</tr>
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<td>Export subsidy</td>
<td>17</td>
<td>Eliminated</td>
</tr>
<tr>
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<td>Diamonds</td>
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</tr>
<tr>
<td>Quantitative restrictions on imports</td>
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<td>Virtually eliminated</td>
</tr>
<tr>
<td>of which:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>74</td>
<td>Virtually eliminated</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>14</td>
<td>Virtually eliminated</td>
</tr>
<tr>
<td>Quantitative restrictions on exports; goods</td>
<td>Diamonds</td>
<td>Diamonds</td>
</tr>
<tr>
<td>of 21 agricultural commodities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trade tax revenue as share of total revenue</td>
<td>7.9</td>
<td>4.0</td>
</tr>
<tr>
<td>Import taxes as share of imports</td>
<td>10.8</td>
<td>4.1</td>
</tr>
<tr>
<td>Export subsidies as a share of GDP</td>
<td>0.3</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Sources: GATT (1993); WTO (1998); IDC South Africa; and Belli, Finger, and Ballivian (1993).

1The figure for 1998 refers to June 1997.
2At ISIC three-digit level; excludes import surcharge.
3The figure for 1990 refers to 1992.
4Actual subsidy disbursements were 2.7 percent of exports in 1990/91.
5The figure for 1990 refers to 1992. As percent of total tariff lines (other than those maintained for health, security, and environmental reasons).

where the reductions were phased over a longer period, see below). This offer was publicly announced in 1994 after extensive consultations with civil society within South Africa. Given the prior progress with liberalizing the quantitative restrictions, the offer, particularly in the manufacturing sector, was focused on tariffs. The offer aimed to:
DYNAMIC GAINS FROM TRADE

- reduce the number of tariff lines (from over 13,000) at the six-digit level by 15 percent in the first year and by 30 percent or higher by 1999;
- convert all quantitative restrictions (QRs) on agricultural imports to bound ad valorem rates; lower all bound agricultural tariffs by 21 percent on average and reduce export subsidies by 36 percent;
- increase the number of bindings on industrial products from 55 percent to 98 percent; replace formula duties with tariffs; and reduce the number of tariff rates to six—0, 5, 10, 15, 20, and 30 percent rates—with the exception of the “sensitive” industries (textiles, clothing, and motor vehicles);
- liberalize the sensitive industries over an eight-year period; and
- phase out the General Export Incentive Scheme by 1997.9

Figure 1 depicts tariff levels and their changes in the different manufacturing sectors during the 1990s. Tariff levels varied considerably across sectors. In 1990, many of the sectors producing inputs (equipment, iron and steel, and chemicals) faced the lowest tariffs, while sectors producing consumer goods such as textiles and clothing, footwear, and automotive products faced very high tariffs. Tariff cuts during the subsequent years also varied considerably across manufacturing sectors. In general, sectors with the highest tariffs in 1990 witnessed the largest cuts between 1990 and 1998. However, these sectors will continue to be the most protected even after the current phase of tariff reductions is implemented.

To summarize, during our focus period, 1990–98, liberalization of the trade regime for manufacturing products resulted in: the elimination of the few quantitative restrictions that remained; reduction in the average tariff (including all charges) from 34 percent in 1990 to 10 percent in 1998; considerable variation in tariff cuts across sectors; and simplification of the tariff regime.

Sanctions and Trade Developments

One important feature of the economic landscape in the 1980s was the imposition of trade and financial sanctions on South Africa. While capital flight from South Africa dates back to the early 1960s, more concerted action by creditors was precipitated in 1985 when a U.S. bank announced that it would not be rolling over its short-term loans to South Africa. Other U.S. banks followed suit, causing a full-blown liquidity crisis for the South African economy. The South African authorities responded by imposing exchange controls and a moratorium on payments to foreign creditors. By the mid to late 1980s, spurred by action in the United States, the Nordic countries, and within the Commonwealth, South Africa faced formal sanctions on its exports of coal, iron and steel, uranium, and agricultural products to a number of industrial countries, and on its imports of petroleum, computer, and high-technology (including nuclear) equipment.

8 A binding represents a legal commitment to not raise tariffs beyond the level embodied in the binding.
9 The GEIS was altered in 1995 in two ways: the magnitude of support was scaled down, and payments under it were made taxable. In 1996, the GEIS was limited to fully manufactured products, and in July 1997 it was entirely eliminated.
Figure 1. Tariff Protection, 1990–98
(In percent)

Tariff levels

Tariff reductions

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Financial sanctions forced South Africa to move from running current account deficits in the early 1980s of over 5 percent of GDP to current account surpluses until the early 1990s. It is less clear, however, whether financial and trade sanctions had a significant impact on South Africa's trading possibilities—either in reducing the actual volume of trade and/or worsening the terms of trade (which could have been the cost of evading the sanctions). Trade data suggest that the impact on trade volumes may not have been significant. Imports actually grew somewhat during the late 1980s, although it accelerated sharply after the removal of sanctions. Likewise, exports increased during the sanctions, and picked-up strongly in the 1990s.

III. Methodology and Data

As indicated in Section I, some of the empirical studies have focused on the determinants of growth in TFP rather than in real GDP. The advantage with such an approach is that there is a stronger presumption that growth in TFP is positively related to trade. As discussed above, trade policy might also affect factor accumulation, but in ways that are theoretically ambiguous, and a study focusing exclusively on output growth would be unable to isolate and capture the effects working through increased efficiency. Thus, in the current study we examine the impact of trade on TFP growth rather than output growth.

The cross-section analysis is based on pooled data for the years 1990–94 and 1994–98 for 24 manufacturing industries (defined at the ISIC 3-digit level). TFP growth was defined as the difference between growth in real value added and real factor accumulation in each sector, with the factor shares—obtained from industry-specific data—used to weight the growth in factors (see Appendix for further details). Figure 2 shows the TFP growth in the 24 manufacturing sectors during the 1990s. It can be noticed that the growth rates tended to be higher after 1994, but also that there was substantial variation in the TFP growth rates across sectors.

The trade variable (Tariff) is a policy variable, namely, the sum of all import charges (tariff and import surcharge) for each sector. The variable $DTariff$ is measured as the change in tariff divided by 1 plus the initial tariff and, hence, reflects the percentage change in domestic price owing to the tariff reduction. Data on tariffs (and all other import charges) were available for the years 1990, 1994, and 1998, although for three sectors (textiles, clothing, and motor vehicles) the announced tariffs for 2002 were used, rather than the actual 1998 tariffs, in order to capture any forward-looking behavior.

That we do not take into account some of the quantitative restrictions that were eliminated during the period 1990–94 could lead to some mismeasurement of our

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10 During the late 1970s, South Africa ran current account surpluses, but this was due to the sharp improvement in the terms of trade associated with a boom in gold prices.

11 See Lipton (1988) for a more elaborate discussion of this issue.

12 All variables beginning with the operator "D" refer to the change in the underlying variable.

13 As explained in Section II, under the Uruguay Round commitments, South Africa announced tariff reductions for these three sectors that would extend to 2002.
Figure 2. TFP Growth, 1990-98
(Annual percentage change)

1990-94

1994-98

1990-98
trade policy variable for this period. However, as noted above, the QRs that did remain in place were small in magnitude and “soft” in terms of their impact as they took the form of automatic import licensing. Moreover, the sectors in which import licensing remained and were eliminated were also the ones that saw the greatest tariff reductions; hence our measure for tariff changes would be highly correlated with a broader measure that took into account the vestigial import restrictions. Our trade policy variable, of course, does not capture the improvements stemming from the reduction in complexity of the tariff regime, but our results should not be overly affected by these changes unless there is reason to believe that their impact was different across manufacturing sectors.14

The time-series variations in the data were examined for the period 1971–97.15 Total factor productivity growth was calculated as the growth in private nonagricultural GDP less the growth in capital and labor, weighted by their respective shares in output derived from the national income accounts (see Subramanian, 1998).16 Openness was measured as the ratio of the sum of real imports and real exports of goods and nonfactor services to real GDP.17 The use of this variable is open to the criticism that it measures an outcome and, hence, may not have policy implications. The preferred estimation strategy in this view would be to use direct measures of trade policy. However, it is difficult to compute a reliable series of “trade policy” over the sample period, especially because of the pervasiveness of nontariff barriers until the late 1980s.

Time series data for R&D in South Africa are not easily available. However, following De Long and Summers (1991), we used the share of investment in equipment and machinery in total investment as the proxy for technology. Insofar as South Africa does not undertake significant amounts of R&D activity, we would expect the bulk of the R&D to be embodied in capital equipment, especially that imported from abroad. By looking at total investment in machinery and equipment, our specification implicitly aggregates R&D undertaken at home and abroad and assumes that the two have similar effects on TFP. An alternative approach that could have disentangled the effects of foreign and domestic R&D would have been to use separate measures for domestic and imported capital goods (or even construct an imported R&D variable à la Coe, Helpman, and Hoffmaister, 1997), but this course was rendered difficult by the absence of data on imported capital goods for the entire sample period.

14Although we had data on effective protection, we chose not to use them for three reasons: first, the data were based on statutory tariffs alone and did not incorporate the impact of the import surcharges, which varied substantially across sectors; second, the effective protection data series contained a few outliers, which raised doubts about its accuracy; and third, nominal protection has a more natural metric and is therefore more easily interpretable.

15See Appendix for data description and sources.

16The time-series analysis was also carried out using an alternative methodology for computing TFP growth based on Sarel (1997). The results obtained were very similar to those reported in the next section (see Jonsson and Subramanian, 2000).

17As alternatives, we used this ratio in nominal terms, as well as the ratio of exports and imports of goods alone to GDP; the results were similar but less robust.
We also tried alternative specifications, including a proxy for human capital, but we dropped these subsequently as the proxy was likely mismeasured.\footnote{The Nehru-Swanson-Dubey (1995) human capital stock series does not cover South Africa. The Barro-Lee (1997) series does cover South Africa but exhibits anomalous movements that raise doubts about its quality. In private correspondence, the authors agreed that this series required further refinement.} Similarly, exogenous influences, such as terms of trade developments and the aggregate capital-labor ratio, were initially included in the analysis, but they did not turn out to be important.\footnote{Macroeconomic policy could also have been considered as a possible determinant of TFP growth, but we chose to ignore it as this variable in general is more important in influencing capital accumulation than TFP growth (see Collins and Bosworth, 1996).}

IV. Results

Cross-Section Evidence

This section focuses on how variations in TFP growth across 24 different manufacturing sectors are related to tariff reductions during the period 1990–98. More precisely, TFP growth across manufacturing sectors for the two sub-periods 1990–94 and 1994–98 are explained in terms of the trade policy changes during these sub-periods. Compared to the time-series analysis discussed below, there are three advantages with this approach: first, the problem in separating true technological progress from aggregate demand-related effects is mitigated, as aggregate shocks are likely to affect all sectors. Similarly, the effect of the lifting of sanctions and its impact on TFP growth, which may be inadequately captured in the time-series analysis, is less of a problem in the cross-section analysis, unless sanctions had a differential impact across manufacturing sectors. Second, the number of observations for measuring the long-run effects is greatly increased. Finally, the independent variable is actual trade policy (import tariffs) rather than trade outcomes.

As mentioned earlier, it is difficult to measure trade policy—both conceptually\footnote{There are well-known problems relating to finding a scalar measure that successfully aggregates protection across sectors. One exception is the measure developed by Anderson and Neary (1994), but its data requirements are fairly onerous.} and empirically—at the aggregate level. However, in the cross-section analysis, we have a fair degree of confidence that we accurately measure the trade policy variable: we include all the charges on imports (surcharges and tariffs); we do not have to worry about the effect of quantitative restrictions as those in manufacturing were virtually eliminated before 1990; and we also measure the impact of the export subsidies.

Table 2 reports the results from regressions of TFP growth on changes in tariffs ($DTariff$). To ensure that this effect was not picking up the impact of other variables, we included four additional variables: the capital-labor ratio ($CLR$), the share of exports in total domestic production ($Exportshare$), the share of imports in total domestic sales ($Importshare$), and the initial level of $Tariff$. The square values of the levels and changes in tariffs were also included in one specification to test for any nonlinear effects. The regression was pooled over the periods 1990–94 and 1994–98, and all regressors, except for $DTariff$, were measured at their initial level in 1990 and...
Table 2. Trade Liberalization and TFP Growth

(Pooled results, 1990-94 and 1994-98)

<table>
<thead>
<tr>
<th>Dependent Variable: DTFP</th>
<th>Constant</th>
<th>Dum9498</th>
<th>CLR</th>
<th>Exportshare</th>
<th>Importshare</th>
<th>Tariff</th>
<th>Tariff-sq</th>
<th>DTariff</th>
<th>DTariff-sq</th>
<th>R-square</th>
<th>Number of obs.</th>
</tr>
</thead>
<tbody>
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<td>-0.07</td>
<td>0.04</td>
<td>-0.17</td>
<td>0.01</td>
<td>-0.16</td>
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</tr>
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</table>

Note: OLS estimations; the t-statistics (in brackets) are based on a heteroskedastic-consistent covariance matrix, see White (1980).

1994, respectively. A time-dummy for the second subperiod (Dum94948) was included, implying that the results are mainly driven by cross-sectional variations in the data.

The results show that there is a significant negative relationship between changes in tariffs and TFP growth across the manufacturing sectors, and this result is robust to the inclusion of the other variables that are possibly important for TFP growth. Of these variables, only CLR enters significantly, indicating that more capital intensive sectors tend to exhibit higher TFP growth rates. The initial level of the tariff, and the

21Our results are susceptible to a potential endogeneity problem. It is conceivable that the sectors that exhibited faster TFP growth were the ones that would have been politically easier to liberalize and hence selected for deeper tariff cuts. In other words, TFP growth may have determined tariff cuts rather than the other way around. However, this argument is empirically implausible because the tariff changes were announced and made in advance of changes in TFP, which the authorities could not have reasonably and accurately predicted. In fact, the only pattern discernible in the tariff actions seems to be that larger reductions took place in sectors with high initial tariffs.
degree of export orientation of, and import penetration in, a sector, appear to be less important in explaining TFP growth rates.

It is also interesting to notice that tariff changes seem to have a nonlinear effect on TFP growth; the marginal effect on TFP growth tends to decline as the tariff reductions become larger. One possible explanation is that this nonlinear impact simply reflects some exogenous limit to TFP growth within the estimated four-year period. These results are illustrated in Figure 3, where the conditional TFP growth is shown on the y-axis. The figure (and the regression results) also illustrate that the quantitative effect of trade liberalization is sizeable; for example, the results indicate that the annual growth rate in TFP was nearly 3 percentage points higher in sectors where tariffs were reduced by 10 percent (or rather, where the price reduction was 10 percent due to tariff reductions) compared with sectors where tariffs were unchanged.

Table 3 depicts the results for the estimations for the two different subperiods, 1990–94 and 1994–98, respectively. It can be noted that the estimated coefficients on $DTariff$ are negative and significant in both subperiods, but that the quantitative effect is somewhat stronger in the latter subperiod. In this subperiod, it was also possible to examine the lagged effects of changes in tariffs on TFP growth. However, the coefficients on these lagged variables were small and insignificant. For the second subperiod we also tested whether changes in the export subsidy affected TFP growth. The export subsidy variable was positively signed (implying that reductions in the GEIS could have adversely affected TFP growth) but insignificant. More importantly, the inclusion of the export subsidy variable does not affect the coefficient of the tariff change variable.

The robustness of the results was examined in several ways. First, to test the sensitivity of the results to individual sectors, 24 additional regressions were run in which the observations from a single sector were dropped alternatively. The estimated coefficient on $DTariff$ always remained negative and significant at the 5-percent level, except in one case where it remained significant at the 10-percent level. Second, to test whether the impact of trade liberalization was confined to the import competing sector, the observations for the two most export oriented sectors were excluded; again the results remained broadly unaffected by this reduction in the sample. Also, various measures of the extent to which a sector is a net exporter were included in the regressions. This variable was added separately (as an alternative to Exportshare and Importshare) but also interacted with $DTariff$. Neither of these coefficients turned out to be significant, but the estimated coefficient on $DTariff$ remained negative and significant. Finally, the average capacity utilization of individual sectors was included in the regressions to capture the possibility of idiosyncratic shocks affecting TFP growth differen-

---

22 It should be recalled that over the first sample period, 1990–94, the export subsidy remained broadly unchanged.

23 One point on the measurement of the export subsidy should be noted. On the one hand, the subsidy provided effective protection to those sectors that received it; on the other hand, insofar as the subsidy was linked to the use of locally produced inputs, its effect was diluted (on the reasonable assumption that the local content requirement was binding). It is not clear that the manner in which the subsidy is measured adequately captures the latter effect.
Figure 3. Conditional TFP Growth and Tariff Changes

$\text{DTFP}(\text{CLR, Exp, Imp, Dum 9498}) = a + b(D\text{Tariff})$

$\text{DTFP}(\text{CLR, Exp, Imp, Dum 9498}) = a + b(D\text{Tariff}) + c(D\text{Tariff} - \text{sq})$
Table 3. Trade Liberalization and TFP Growth; Results for Subperiods

<table>
<thead>
<tr>
<th></th>
<th>1990-94</th>
<th>1994-98</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable: DTFP</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-2.03</td>
<td>-0.69</td>
</tr>
<tr>
<td></td>
<td>[-1.96]</td>
<td>[-0.17]</td>
</tr>
<tr>
<td>CLR</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>[-0.04]</td>
<td>[-0.02]</td>
</tr>
<tr>
<td>Exportshare</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>[3.52]</td>
<td>[3.75]</td>
</tr>
<tr>
<td>Importshare</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>[0.52]</td>
<td>[0.67]</td>
</tr>
<tr>
<td>Tariff</td>
<td>-0.11</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>[-0.87]</td>
<td>[0.43]</td>
</tr>
<tr>
<td>Tariff-sq</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>[1.56]</td>
<td>[-0.89]</td>
</tr>
<tr>
<td>DTariff</td>
<td>-0.43</td>
<td>-0.46</td>
</tr>
<tr>
<td></td>
<td>[-2.57]</td>
<td>[-1.75]</td>
</tr>
<tr>
<td>DTariff-sq</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>[2.45]</td>
<td>[1.92]</td>
</tr>
<tr>
<td>DTariff (-1)</td>
<td>-0.51</td>
<td>-0.63</td>
</tr>
<tr>
<td></td>
<td>[-2.57]</td>
<td>[-1.75]</td>
</tr>
<tr>
<td>DTariff-sq (-1)</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>[2.45]</td>
<td>[1.92]</td>
</tr>
<tr>
<td>DGEIS</td>
<td>0.11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[1.39]</td>
<td></td>
</tr>
<tr>
<td>R-square</td>
<td>0.40</td>
<td>0.49</td>
</tr>
<tr>
<td>Number of obs.</td>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>

Note: OLS estimations; the t-statistics (in brackets) are based on a heteroskedastic consistent covariance matrix (see White (1980)).

...ssually across sectors. This variable was not significant and it did not affect the importance of the tariff change variable.

While the results thus far appear strong, it is possible that they are driven by the impact of trade liberalization on employment. If this impact is negative, TFP growth may have increased because firms have fired less productive workers as tariffs were reduced in order to stay competitive. This is an important issue to
clarify in the case of South Africa because employment fell almost continuously during the 1990s; in the manufacturing sector, employment fell in 18 of the 24 sectors examined in this study between 1990–98. However, although this is a plausible hypothesis, the data do not lend support to it.

Table 4 reports regression results similar to those discussed above, but in which the dependent variable is employment growth, capital growth, or the growth in capital intensity \((C/L)\), rather than TFP growth. There is no evidence for the hypothesis that the tariff reductions are positively related to the employment decline across the manufacturing sectors. In fact, the coefficient on \(DTariff\) is negatively signed, indicating that, if anything, employment has fallen less in the sectors where tariffs have been reduced more aggressively.\(^{24}\) Instead, it can be noticed that capital growth is positively related to changes in tariffs. This result suggests that in sectors that experienced larger tariff reductions, firms have tended to use the existing capital stock more efficiently. Taken together, the data reveal that capital intensity increased more in the sectors that remained relatively highly protected (i.e., where tariffs were reduced less) during the 1990s, rather than the opposite.

**Time-Series Evidence**

This section provides time-series results that corroborate the cross-sectional evidence. A cursory examination of the data indicates that both total factor productivity \((TFP)\) and openness \((Open)\) increased during the 1990s (see Figure 4). Following the discussion in Section III, a series of machinery and equipment investment in total investment \((MachInv)\) was also included in the model as a proxy for R&D activities. Conventional tests of the time-series properties of the three variables—\(TFP, Open,\) and \(MachInv\)—indicate that they are individually integrated of order one.\(^{25}\) Thus, the long-run relationship among the variables was estimated using the cointegration tests proposed by Johansen (1988) and Johansen and Juselius (1990).

The results from the Johansen tests (see Table 5) clearly indicate that there exists one long-run cointegrating vector among \(TFP, Open,\) and \(MachInv.\) Moreover, restricted cointegration tests indicate that all three variables are individually non-stationary;\(^{26}\) at the same time, all three variables contribute significantly to the cointegrating vector. In addition, the coefficients of the cointegrating vector have the expected signs: \(TFP\) is positively related to \(Open\) and \(MachInv.\)\(^{27}\) An examination of the speed of convergence coefficients (the

\(^{24}\)The regressions in Table 4 are not structural equations for factor accumulation and should therefore be interpreted with caution. However, even after controlling for variables such as nominal and real wage growth and labor productivity, the basic conclusion with regard to the relationship between employment growth and tariff reductions remains robust.

\(^{25}\)The results are reported in Jonsson and Subramanian (2000).

\(^{26}\)It can be noted that these tests have stationarity as the null hypothesis, as opposed to the more conventional Dickey-Fuller type of tests. Nevertheless, both tests indicate that it is appropriate to treat the series as non-stationary.

\(^{27}\)One lag was included in the cointegration models. Although a visual inspection of the cointegrating vector suggests that a time trend should be included in the model, a formal test rejected this hypothesis.
Table 4. Trade Liberalization and Factor Accumulation
(Pooled results, 1990-94 and 1994-98)

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>Employment Growth</th>
<th>Capital Growth</th>
<th>Growth in C/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.55</td>
<td>6.15</td>
<td>7.61</td>
</tr>
<tr>
<td></td>
<td>[-2.69]</td>
<td>[3.36]</td>
<td>[4.21]</td>
</tr>
<tr>
<td>Dum9498</td>
<td>2.33</td>
<td>2.54</td>
<td>-0.22</td>
</tr>
<tr>
<td></td>
<td>[2.73]</td>
<td>[2.67]</td>
<td>[-0.14]</td>
</tr>
<tr>
<td>CLR</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.01</td>
</tr>
<tr>
<td></td>
<td>[-0.93]</td>
<td>[-1.08]</td>
<td>[-1.65]</td>
</tr>
<tr>
<td>Exportshare</td>
<td>-0.12</td>
<td>-0.12</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>[-3.55]</td>
<td>[-3.52]</td>
<td>[1.86]</td>
</tr>
<tr>
<td>Importshare</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.11</td>
</tr>
<tr>
<td></td>
<td>[-0.61]</td>
<td>[-0.59]</td>
<td>[-2.56]</td>
</tr>
<tr>
<td>DTariff</td>
<td>-0.16</td>
<td>-0.32</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td>[-3.06]</td>
<td>[-1.78]</td>
<td>[2.59]</td>
</tr>
<tr>
<td>DTariff-sq</td>
<td>0.01</td>
<td>-0.03</td>
<td>-0.04</td>
</tr>
<tr>
<td>R-square</td>
<td>0.29</td>
<td>0.33</td>
<td>0.28</td>
</tr>
<tr>
<td>Number of obs.</td>
<td>48</td>
<td>48</td>
<td>48</td>
</tr>
</tbody>
</table>

Note: OLS estimations; the \( t \)-statistics (in brackets) are based on a heteroskedastic consistent covariance matrix, see White (1980).

alpha matrix) indicates that both TFP and Open are "error-correcting" whereas MachInv can be treated as weakly exogenous. The absence of a weak exogeneity result for Open implies that the estimation of a single first-difference equation with TFP as the dependent variable could be problematic. However, as will be discussed below, this apparent absence of weak exogeneity for the openness variable seems to be a small sample problem rather than a true simultaneity problem, as various stability tests clearly show that only TFP is error-correcting.

Hence, in a second step, a single equation error-correction model was used to examine the annual fluctuations in the variables (see Table 6). The fit of these regressions was remarkably good, considering the small sample size. Moreover, the estimated coefficients for both DOpen and DMachInv have the expected positive sign and are significant,\(^{28}\) while the estimated coefficient for the lagged error correction term (EC) is negative, as expected, and significant.

Recursive regressions show that the estimated coefficients in the error correction model are stable, and no trend breaks could be detected (see Figure 5a). These results tend to support the case for treating the openness variable as weakly exogenous. Indeed, recursive regressions using DOpen as a dependent variable show that the estimated coefficient on the error-correction term is highly unstable and

\(^{28}\)The first lags of all variables were included in a first specification, but the estimated coefficients were insignificant and the lags were dropped.
Figure 4. South Africa: Time-Series Data, 1971-97
(Levels (solid lines) on left-hand scale; first-differences (dashed lines) on right-hand scale)

TFP

Openness: (Exports + Imports)/GDP

Machinery and Equipment Investment in Total Investment

Capacity Utilization

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<table>
<thead>
<tr>
<th>Rank</th>
<th>Eigenvalue</th>
<th>Lambda</th>
<th>Critical Value (95%)</th>
<th>Trace</th>
<th>Critical Value (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>r = 0</td>
<td>0.67</td>
<td>29.08**</td>
<td>21.0</td>
<td>36.92**</td>
<td>29.7</td>
</tr>
<tr>
<td>r &lt;= 1</td>
<td>0.18</td>
<td>5.22</td>
<td>14.1</td>
<td>7.85</td>
<td>15.4</td>
</tr>
<tr>
<td>r &lt;= 2</td>
<td>0.10</td>
<td>2.63</td>
<td>3.8</td>
<td>2.63</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Standardized Eigenvectors

<table>
<thead>
<tr>
<th>TFP</th>
<th>Open</th>
<th>MachInv</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-0.52</td>
<td>-0.32</td>
</tr>
<tr>
<td>-1.92</td>
<td>1</td>
<td>-0.28</td>
</tr>
<tr>
<td>3.57</td>
<td>-8.70</td>
<td>1</td>
</tr>
</tbody>
</table>

Tests for Stationarity of a Given Variable

<table>
<thead>
<tr>
<th>TFP</th>
<th>Open</th>
<th>MachInv</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-sq (1)</td>
<td>25.53**</td>
<td>26.33**</td>
</tr>
<tr>
<td>p-value</td>
<td>(0.00)</td>
<td>(0.00)</td>
</tr>
</tbody>
</table>

Tests for Significance of a Given Variable

<table>
<thead>
<tr>
<th>TFP</th>
<th>Open</th>
<th>MachInv</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-sq (1)</td>
<td>8.91**</td>
<td>7.59**</td>
</tr>
<tr>
<td>p-value</td>
<td>(0.00)</td>
<td>(0.01)</td>
</tr>
</tbody>
</table>

Tests for Stationarity of Weak Exogeneity

<table>
<thead>
<tr>
<th>TFP</th>
<th>Open</th>
<th>MachInv</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-sq (1)</td>
<td>9.77**</td>
<td>10.76**</td>
</tr>
<tr>
<td>p-value</td>
<td>(0.00)</td>
<td>(0.00)</td>
</tr>
</tbody>
</table>

Cointegrating Vector

![Graph showing the cointegrating vector from 1971 to 1997.]

Notes: See Appendix for definitions of variables. * and ** indicate rejection of the null hypothesis at the 5-percent and 1-percent significance level, respectively.
Table 6. The Error-Correction Model: TFP Growth and Openness, 1971-97

<table>
<thead>
<tr>
<th></th>
<th>Constant</th>
<th>1.08</th>
<th>1.02</th>
<th>0.90</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>[2.29]</td>
<td>[2.89]</td>
<td>[2.47]</td>
</tr>
<tr>
<td>EC(-1)(^1)</td>
<td>-0.26</td>
<td>-0.25</td>
<td>-0.22</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[-2.29]</td>
<td>[-2.89]</td>
<td>[-2.46]</td>
<td></td>
</tr>
<tr>
<td>DOpen</td>
<td>0.34</td>
<td>0.27</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[2.50]</td>
<td>[2.60]</td>
<td>[2.87]</td>
<td></td>
</tr>
<tr>
<td>DMachInv</td>
<td>0.16</td>
<td>0.07</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[2.52]</td>
<td>[1.21]</td>
<td>[0.77]</td>
<td></td>
</tr>
<tr>
<td>DCapacity</td>
<td>0.38</td>
<td></td>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[4.18]</td>
<td></td>
<td>[4.06]</td>
<td></td>
</tr>
<tr>
<td>Dum8592</td>
<td></td>
<td></td>
<td>-0.004</td>
<td>[-1.16]</td>
</tr>
<tr>
<td>DW-statistic</td>
<td>2.07</td>
<td>2.06</td>
<td>2.04</td>
<td></td>
</tr>
<tr>
<td>R-square</td>
<td>0.78</td>
<td>0.88</td>
<td>0.89</td>
<td></td>
</tr>
<tr>
<td>Number of obs.</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

Note: t-statistics in brackets.

\(^1\)The error-correction term is derived from the cointegration relation among TFP, Open, and MachInv.

shifts sign over time, indicating that this variable is not really error-correcting but rather should be treated as weakly exogenous (Figure 5b). We take these findings as broadly supportive of the proposition that causation runs from increased openness to higher TFP growth, rather than the converse.

One potentially important problem with the short-run growth regressions is the sensitivity of the measured level of TFP to the business cycle. For example, if it is difficult to adjust the capital stock in the short run, and/or if the labor market is inflexible, leading to labor hoarding behavior on the part of firms, the measured level of productivity would be higher during booms and lower during recessions. Such an omitted variable problem could, in turn, generate a simultaneity problem: depending on the magnitude of the export and import elasticities, output fluctuations related to the business cycle could lead to fluctuations in import and export shares of GDP, that is, openness.

To deal with this problem, the change in capacity utilization in the manufacturing sector (DCapacity) was added as an independent variable in the error-correction model. As expected, the estimated coefficient on this variable came out positive and strongly significant, indicating that the growth rate in TFP in a
Figure 5. Stability Tests of Error-Correction Model
(Beta-coefficients ± 2 standard errors and Chow tests)

Figure 5a. \( DTFP \) as Dependent Variable

\[
EC(-1) \\
\begin{array}{c}
0.5 & 0 & -0.5 & -1.0 \end{array}
\]

\[
DOpen \\
\begin{array}{c}
0 & 1 & 1.5 \end{array}
\]

\[
DMachInv \\
\begin{array}{c}
1.5 & 1 & 0.5 \end{array}
\]

Chow test (5 percent critical value)

Figure 5b. \( DOpen \) as Dependent Variable

\[
EC(-1) \\
\begin{array}{c}
1 & 0.5 & 0 & -0.5 \end{array}
\]

\[
DTFP \\
\begin{array}{c}
1.5 & 1 & 0.5 \end{array}
\]

\[
DMachInv \\
\begin{array}{c}
1 & 0.5 \end{array}
\]

Chow test (5 percent critical value)
particular year does not necessarily reflect an improvement in technology.\textsuperscript{29} Still, the coefficients on $D\text{Open}$ and $EC$ were virtually unaffected by the inclusion of $DC\text{apacity}$. In contrast, the coefficient on $DM\text{achInv}$ drops sharply and becomes insignificant, suggesting that firms invest less in machinery and equipment during recessions. Finally, a dummy variable for the period 1985–92, during which South Africa was subject to trade and financial sanctions ($D\text{um8592}$), was also included in one specification, but did not turn out to be significant.

To summarize, the time-series evidence goes in the same direction as the cross-sectional results: there exists a robust long-run relationship among TFP, the degree of openness (measured as imports plus exports over GDP), and the share of machinery and equipment investment in total investment. In addition, annual growth in TFP is positively (and significantly) related to contemporaneous changes in openness, and temporary deviations from the long-run relationship are restored primarily by adjustments in the level of TFP, rather than through changes in imports and exports or in investment in equipment and machinery. The quantitative effects seem to be quite large: the estimated coefficients indicate that a 10 percentage point increase in openness is associated with an increase in TFP by about 5 percent in the long run. Similarly, an increase in the share of machinery and equipment investment of 10 percentage points is associated with an increase in TFP by about 3 percent in the long run.

V. Discussion and Conclusions

The proposition that trade is beneficial to dynamic efficiency (and not just to static economic welfare) is theoretically ambiguous and the empirical evidence supporting it has been questioned. In this paper, we have tested this proposition for South Africa using a cross-section approach covering the manufacturing sectors for the period 1990–98 when South Africa witnessed major trade reform, and an aggregate time-series approach (covering the period 1970–97). Both approaches validate the above proposition with a high degree of statistical reliability.

The results obtained in this paper indicate that trade liberalization has contributed significantly to augmenting South Africa’s long-run growth potential via its impact on TFP growth. For example, the average price reduction in the 1990s due to the tariff changes was about 14 percent in manufacturing, which translates to higher TFP growth of about 3 percent per year. The time-series analysis yields surprisingly similar results; the openness ratio increased by about 3.2 percentage points per year on average during the period 1990–97 which, according to our long-run results, contributed to TFP growth of about 1.6 percent per year. The actual annual growth in TFP between 1990–97 was 1.8 percent, implying that increased openness accounted for close to 90 percent of the actual TFP growth in that period.

\textsuperscript{29}It should be noted that the variable $Cap\text{acity}$ was not included in the cointegration setup, as fluctuations in this series would mainly be important in explaining short-run developments. Nevertheless, the desirable statistical properties of the error correction model should be unaffected, since $DC\text{apacity}$ clearly is stationary. Other measures of the business cycle, including an indicator proposed by the Economics Department of the South African Reserve Bank, generated qualitatively the same results.
The high level of unemployment is, arguably, the most serious macroeconomic problem in South Africa. A concern among policymakers and analysts has been that trade liberalization could aggravate the unemployment problem, as firms might reduce the size of the workforce to remain competitive. However, the results in this study indicate that this concern is unfounded; employment has tended to fall less in the sectors where tariffs have been reduced more aggressively.

A comparison of the “footwear” and “chemical” sectors vividly illustrates this point. The “footwear” sector employed 33,000 people in 1990 and was relatively highly protected by an import tariff of 47 percent. The sector remained quite protected during the 1990s, as the tariff was reduced to only 34 percent by 1998. Despite this continued protection, employment fell on average by 5 percent per year to 22,000 by 1998. Moreover, total factor productivity fell on average by 1.9 percent per year, and value added fell on average by 5.1 percent per year. In contrast, the sector “other chemical products” employed 64,000 people in 1990, and the tariff was 29 percent. By 1998, the tariff had been slashed to 5 percent. Nevertheless, employment had increased on average by 1 percent per year to 68,000, and, at the same time, the sector had improved its efficiency: total factor productivity increased on average by 1.3 percent per year, while value added grew on average by 2.6 percent per year.

The time-series results regarding the joint importance of the openness and the technology variable draw attention to two key and complementary channels of influence on the economy’s productivity. While R&D, as embodied in investment in machinery and equipment, augments productivity, it also appears to be important to provide an open or liberal environment in which the gains from R&D can be maximized. A policy corollary of this finding could be that emphasis on increasing an economy’s access to foreign capital goods—by, say, selectively liberalizing imports of capital goods—might be insufficient to harness the benefits from technology absorption. By the same token, the results suggest that an open environment needs to be complemented by appropriate avenues for the creation and absorption of technology.

While we find the results in this paper encouraging, there remains considerable scope for refining and deepening the research agenda. In particular, it would be interesting to explore the impact of trade liberalization at plant-level. Plant-level data exist for the manufacturing sector (in the form of the manufacturing census) for 1991 and 1993 and those for 1996 were expected to be released in 2000. These would constitute a rich data set for examining issues related to trade, concentration, and efficiency, as has been done for Turkey (Levinsohn, 1992) and Côte d’Ivoire (Harrison, 1994).
APPENDIX
Data Description and Sources

A. Cross-Sectional Analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$DTPF$</td>
<td>Annual average of growth in real value added in a sector minus the factor share weighted growth in capital stock and employment; factor share is in nominal terms.</td>
<td>Industrial Development Corporation of South Africa (IDC)</td>
</tr>
<tr>
<td>Exportshare</td>
<td>Exports divided by production (in current prices).</td>
<td>IDC</td>
</tr>
<tr>
<td>Importshare</td>
<td>Imports divided by domestic consumption (in current prices).</td>
<td>IDC</td>
</tr>
<tr>
<td>$D_{tariff}$</td>
<td>Change in tariff divided by 1 plus initial tariff.</td>
<td></td>
</tr>
<tr>
<td>$Dum_{9498}$</td>
<td>Dummy variable that takes a value of 1 for the period 1994–98 and 0 otherwise.</td>
<td></td>
</tr>
<tr>
<td>$C/L$</td>
<td>Capital stock in constant prices divided by employment.</td>
<td>IDC</td>
</tr>
</tbody>
</table>

1The data refer to the following 24 International Standard Industrial Classification (ISIC) three-digit subsectors within the manufacturing sector: food processing, beverages, textiles, clothing, leather, footwear, wood and wood products, furniture, paper and paper products, printing and publishing, basic chemicals, other chemical products, rubber products, plastic products, glass and glass products, other nonmetallic minerals, basic iron and steel, basic non-ferrous metals, metal products, machinery and equipment, electrical machinery, motor vehicles, transport equipment, and other manufacturing.
### B. Time-Series Analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TFP</strong></td>
<td>Index (in natural logarithms) of growth in private nonagricultural GDP minus growth in capital and labor, weighted by their respective shares in output; factor shares based on national income accounts.</td>
<td>Subramanian (1998)</td>
</tr>
<tr>
<td><strong>Open</strong></td>
<td>Real imports and real exports of goods and nonfactor services divided by real GDP.</td>
<td>South African Reserve Bank (SARB), <em>Quarterly Bulletin</em>, 1998</td>
</tr>
<tr>
<td><strong>MachInv</strong></td>
<td>Share of investment in machinery and equipment in total gross fixed capital formation.</td>
<td>SARB, <em>Quarterly Bulletin</em>, 1998</td>
</tr>
<tr>
<td><strong>DCapacity</strong></td>
<td>Change in capacity utilization in manufacturing.</td>
<td>SARB, <em>Quarterly Bulletin</em>, 1998</td>
</tr>
<tr>
<td><strong>Dum8592</strong></td>
<td>Sanctions dummy taking a value of 1 for the period 1985-92 and 0 otherwise.</td>
<td></td>
</tr>
</tbody>
</table>

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