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Contents

Taxation, Growth And Welfare: A Framework For Analysis And Some Preliminary Results

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A shift away from the taxation of capital toward taxation of consumption is potentially welfare-enhancing….[E]ven larger welfare gains might be obtained by substituting consumption taxes for taxes on labor income.

The belief that the U.S. tax code ought to treat capital more favorably than it currently does has become a perennial of political discourse in recent years. Proposed changes in the tax code have ranged from the relatively modest, such as reducing the tax rate on capital gains, to the more radical, such as a switch to a flat tax (which would eliminate double taxation of capital income) and "ending the IRS as we know it." Reform proposals are usually accompanied by claims that the reforms, if implemented, would yield a myriad of benefits to taxpayers generally, foremost among these benefits being an increase in the economy's long-run growth rate. Yet it is only in the past decade or so that economists have developed the tools that allow us to assess the validity of these claims. The objectives of this article are, first, to present some comparative statistics on how heavily capital is taxed in the United States relative to the other major industrialized countries; second, to outline a simple model that allows us to address some of the claims about how changes in the capital tax rate would affect the economy's long-run growth rate and the well-being of the average household; and third, to perform some simple "reform experiments" illustrating the potential magnitude of the gains that could accompany tax reforms.

The basic principles of optimal taxation were first worked out by Ramsey (1927). One of Ramsey's contributions was to demonstrate formally that under certain circumstances the optimal tax rates on different commodities would be inversely proportional to their elasticities of supply and demand. That is, if the supply or demand for some commodity is absolutely inelastic, then all tax revenue should be raised by taxing that commodity because doing so will entail no loss of welfare. In the short run, the quantity of capital supplied to productive activities is in fixed supply, and arguably, therefore, one should raise as much revenue as possible from taxes on capital.[1] However it was not until the 1970s that economists developed a deeper understanding of the welfare costs of financing government expenditures with taxes on capital.

Feldstein (1978, 1974a, and 1974b) presented the pioneering analysis that challenged the notion that we could safely abstract from the decision to accumulate capital when evaluating the welfare costs of capital taxation, albeit in environments that restricted the response of either households or markets to policy changes. The first general equilibrium analysis of the effects of capital taxation was presented by Chamley (1981), who studied the welfare con-

sequences of eliminating a tax on capital. A more detailed analysis was presented by Judd (1987), who compared the welfare cost associated with the taxation of capital and labor income.

All these studies (and a substantial number of others) found that there would be significant welfare gains associated with the elimination of capital income taxation or, more realistically, the replacement of such taxation with higher taxes on consumption and labor. However, none of these studies allowed for any feedback to the long-run growth rate of the economy. All the analyses were conducted in the context of models in which the long-run growth rate was determined exogenously, or by factors outside the model. Insofar as the elimination or reduction of tax rates on capital income had any growth effects, they were transitory as the economy adjusted to a new long-run growth path. It was not until the development of models of endogenous growth in the 1980s that economists could begin to ask whether tax policy had any effect on the economy's long-run growth rate. These models, which were pioneered by Romer (1986), Lucas (1988), and Rebelo (1991), were in part motivated by the desire to construct a framework within which we could begin to meaningfully address the very long-run consequences of certain policies (this was especially true in the case of Rebelo 1991).

The seminal study of tax policy in the context of an endogenous growth model is by Lucas (1990, 293 and 314), who writes:

> When I left graduate school, in 1963, I believed that the single most desirable change in the U.S. tax structure would be the taxation of capital gains as ordinary income. I now believe that neither capital gains nor any of the income from capital should be taxed at all….The supply-side economists…have delivered the largest genuinely free lunch I have seen in 25 years in this business, and I believe we would have a better society if we followed their advice.

Lucas (1990, 314) estimates the gain in welfare from the elimination of all capital taxation in the United States to be around 1 percent of annual consumption and notes for comparison that "it is about twice the welfare gain that I have elsewhere estimated would result from eliminating a 10 percent inflation, and something like 20 times the gain from eliminating post-war-sized business fluctuations. It is about 10 times the gain Arnold Harberger…once estimated from eliminating all product-market monopolies in the U.S." Subsequent studies by, among others, King and Rebelo (1990) and Jones, Manuelli, and Rossi (1993) have tended to reinforce Lucas' findings about the benefits of eliminating capital income taxation.

In what follows, I examine a prototypical multiple-sector model of endogenous growth and use it to explore the welfare consequences of some fairly simple tax reforms. One key difference from existing analyses is that I use recently constructed estimates of average marginal tax rates on capital and labor income and consumption to calibrate the model. The "reforms" I consider consist of a halving of the tax rates on capital income, labor income, and consumption from their average levels over the past thirty years. I find that there would be a significant welfare gain associated with a reduction in the tax rate on capital income and its replacement with a consumption tax. However, I also show that there could be an even larger gain associated with a reduction in the tax rate on labor income. This possibility arises because of the importance of human capital accumulation for the growth process.

The findings in this article reinforce the general principle of efficient taxation that factors that are supplied inelastically should be taxed relatively more than factors that are supplied elastically. In the analysis below, the only factor that is supplied inelastically is raw, unimproved labor. The return to raw labor is inextricably tied to the return on human capital, which is supplied elastically in the long run, and so efficiency dictates that the burden of taxation be shifted toward consumption purchases as a proxy for taxing raw labor. In the model economy studied below, the first-best tax scheme would be to raise all revenue by taxing consumption and to exempt both labor and capital income from taxation.

Factor income taxation in the United States

Research on the aggregate implications of changes in tax policy has long been hindered by the lack of data on measures of the tax rates on labor and capital income that correspond to the relevant concepts suggested by economic theory. For the United States, a number of authors have attempted to construct measures of average marginal tax rates on total income using data on individual tax returns (for example, Barro and Sahasakul 1983). However, these estimates do not distinguish between income derived from

labor and income derived from physical capital. As for international comparisons, the problem is compounded by differences in tax laws across countries.

Recently, however, Mendoza, Razin, and Tesar (1994) have tried to remedy this problem by constructing estimates of tax rates on capital and labor income, as well as on consumption expenditure, for the G–7 industrial countries for the period 1965–89. Their estimates aggregate all the various deductions, allowances, and so forth in a single measure and are the relevant empirical counterparts to the tax variables considered in dynamic economic models of the sort I examine below. Their measures of tax rates are constructed as follows.

The average effective tax rate on sales of consumption goods, τ^C, is defined as the ratio of the sum of tax revenues from general taxes on goods and services plus revenues from excise taxes to the consumption tax base. The consumption tax base is measured as the sum of private final consumption expenditures and government final consumption expenditures, less compensation of employees paid by producers of government services and tax revenues from general taxes on goods and services and excise taxes.

To construct a measure of the effective tax rate on labor income, Mendoza, Razin, and Tesar start by constructing a measure of the average tax rate on total income that households receive. This tax rate, τ^H, is defined as the ratio of the total revenue from taxation of the income, profits, and capital gains of individuals to the sum of the operating surplus[2] of private unincorporated enterprises, households' property, entrepreneurial income, and wage and salary payments received by the household sector.

The estimate of the tax rate on labor income, τ^W, is then constructed as the product of the tax rate on total household income and wage and salary earnings, plus total social security contributions and taxes on payroll and workforce (which do not exist in the United States), expressed as a fraction of the tax base for labor income taxes. The tax base for labor income taxes is measured as the sum of wage and salary payments and employers' contributions to social security.

The numerator of tax rate on capital income, τ^R, is constructed as the product of the average tax rate on total income and the operating surplus of private unincorporated enterprises plus households' property and entrepreneurial income, to which is added the taxes on the income, profits, and capital gains of corporations; recurrent taxes on immovable property; and taxes on financial and capital transactions. The denominator is the base for capital taxation, which is simply the operating surplus of the economy.

Figures 1 through 3 present Mendoza, Razin, and Tesar's tax rate estimates, which I have extended through 1994 using data from recent issues of the Organization for Economic Cooperation and Development's National Accounts and Revenue Statistics publications. The figures reveal a number of interesting differences in tax policy across the major industrialized countries. First, note that the tax rate on capital income in the United States is relatively high in comparison with those of other G–7 countries. In many years, the tax rate on capital income in the United States is exceeded only by the ludicrous levels of capital income taxation in the U.K., although note that toward the end of the sample, capital tax rates in Canada and Japan overtake those of the United States. There is no noticeable trend in the tax rate on capital income in the United States, and the only country for which such a trend (toward higher taxation of capital income) is apparent is Japan, the country that posted the most impressive growth performance over this period. However, even in Japan this trend seems to have reversed itself in the late 1980s.

Second, note that for all the countries there is a noticeable trend toward heavier taxation of labor income over most of this period, with the overall level of taxation on labor income in the United States being around the middle of the pack. Note that this trend seems to reverse itself in the early 1980s in the U.K., in the late 1980s in the United States, and in the early 1990s in Japan.

Figure 1
Capital Tax Rates in G–7 Countries

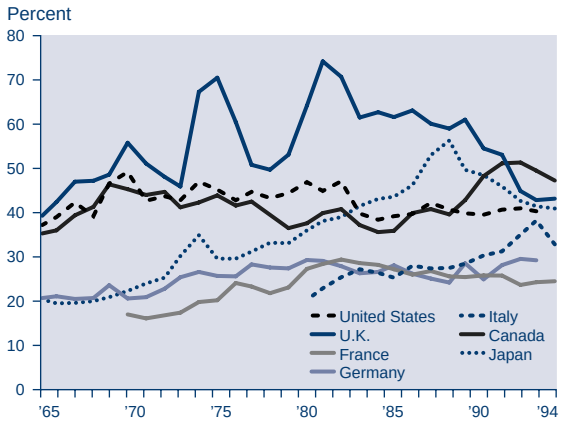
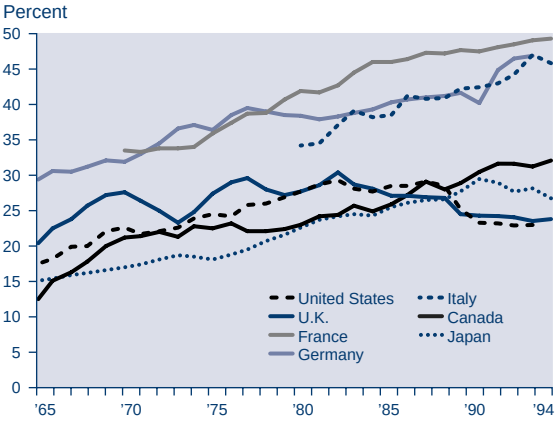


Figure 2
Labor Tax Rates in G–7 Countries



Finally, note that there is no discernible trend in the rate of taxation of consumption expenditures. The lowest tax rates on consumption spending are in Japan and the United States (both in the 4.5 percent to 6.5 percent range), and the highest rates of consumption taxation are in France. Comparing the levels of the three types of taxes, it is striking how much more heavily all the countries tax capital, as opposed to either consumption or labor.

A model with endogenous growth

To get a handle on some of the issues raised in the introduction, it is necessary to lay out a model that allows tax policy to affect the economy's long-run growth rate. In this section, I develop such a model. I consider an economy in which households divide their time among three different production activities: producing goods that are consumed, producing capital goods for use in production activities, and producing human capital that augments the productivity of raw effort. I assume that factors (labor and physical capital) supplied to each of these activities are subject to taxation and that the tax rate is the same regardless of the sector to which factors are supplied. I also assume that the household sector owns all physical capital and that human capital is embodied in individuals and cannot be supplied independently of effort. Government activity will be restricted to levying distortionary taxes on labor and capital income and on consumption purchases, with the proceeds from these taxes distributed to the household sector in a lump-sum manner.

The representative household is assumed to have preferences over consumption of final goods and leisure, as summarized by the following functional:

$$(1) \qquad \sum_{t=0}^{\infty} \beta^t U(C_t, L_t),$$

where C_t denotes consumption at date t, L_t denotes leisure or time devoted to nonmarket activities at date t, and I assume that the discount factor satisfies $1 > \beta > 0$. Note I am abstracting from consumer durables here: consumption services that yield utility are identical to purchases of consumer goods.[3]

I assume that the point-in-time utility function takes the following specific functional form:

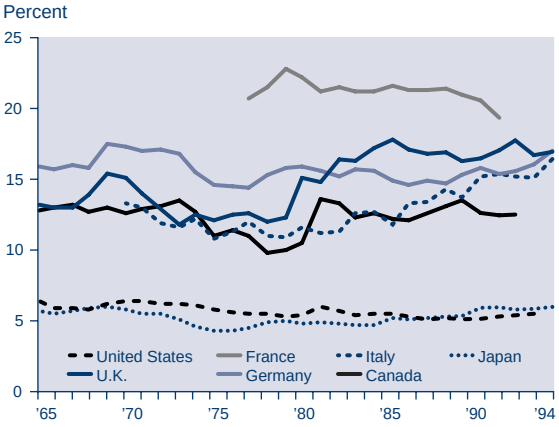
$$(2) \qquad U(C_t, L_t) = \log(C_t) + \theta \log(L_t),$$

with $\theta > 0$. The representative household is assumed to choose a lifetime plan for consumption and leisure at each date that maximizes utility subject to the following budget constraint:

$$(3) \qquad (1+\tau_t^C)C_t + P_t^K I_t^K + P_t^H I_t^H \leq W_t(1-\tau_t^W)H_t N_t + R_t(1-\tau_t^R)K_t + T_t,$$

where τ_t^C denotes the tax on consumption purchases at date t, P_t^K denotes the relative price of physical capital in terms of consumption goods at date t, I_t^K denotes purchases of new physical capital goods at date t, P_t^H denotes the relative price of human capital in terms of consumption goods at date t, I_t^H denotes purchases of new human capital at date t, W_t denotes the wage rate in terms of consumption goods at date t, τ_t^W denotes the tax rate on labor income at date t, H_t denotes the total stock of human capital available for use in production at date t, N_t denotes the total number of hours devoted to market production at date t, R_t denotes the rental rate on physical capital at

Figure 3
Consumption Tax Rates in G–7 Countries



date t, τ_t^K denotes the tax rate on income from physical capital at date t, K_t denotes the total stock of physical capital available for use in production activities at date t, and T_t denotes transfer payments from the government received at date t.

I also assume that the amount of time available for market and nonmarket (or leisure) activities is normalized to 1, yielding the following constraint on the allocation of time across activities:

$$L_t + N_t^C + N_t^K + N_t^H \leq 1, \tag{4}$$

where N_t^C denotes hours devoted to production of consumption goods at date t, N_t^K denotes hours devoted to the production of physical capital at date t, and N_t^H denotes hours devoted to the production of human capital at date t. Obviously, $N_t = N_t^C + N_t^K + N_t^H$. Finally, I assume the following constraints on the accumulation of physical and human capital:

$$K_{t+1} \leq (1 - \delta^K)K_t + I_t^K \tag{5}$$

and

$$H_{t+1} \leq (1 - \delta^H)H_t + I_t^H, \tag{6}$$

where $1 \geq \delta^K \geq 0$ denotes the rate of depreciation of physical capital and $1 \geq \delta^H \geq 0$ denotes the rate of depreciation of human capital.

A few comments are in order. I am assuming that the representative household is infinitely lived, although this assumption is not really crucial for what follows. An alternative, the dynastic interpretation, has those making decisions today taking into account the welfare of future generations.[4] I assume that the household must divide its time between leisure (or nonmarket) activities and three different market activities—namely, the production of consumption goods, the production of physical capital, and the production of human capital. I assume that time spent in each of these market activities is equally distasteful from the perspective of the representative household and, furthermore, that labor income generated in each of these activities is taxed at the same rate, τ^W. Total (pretax) labor income equals WHN, where $H = H^C + H^K + H^H$ and $N = N^C + N^K + N^H$. Because effort can be costlessly reallocated among the three market activities, the real wage will be the same in all three. Note that W is the wage per efficiency hour of effort in each sector. I assume that physical capital is accumulated by households and leased to firms at the prevailing rental rate, R.

Again, because physical capital can be costlessly reallocated among the three market activities, the rental rate will be the same in all three sectors. Finally, note that I assume that the household receives a lump-sum transfer payment from the government equal to T.

The technologies for producing the three types of goods are as follows:

$$C_t \leq A^C (K_t^C)^{\alpha^C} (H_t^C N_t^C)^{1-\alpha^C}, \tag{7}$$

$$I_t^K \leq A^K (K_t^K)^{\alpha^K} (H_t^K N_t^K)^{1-\alpha^K} \text{ and} \tag{8}$$

$$I_t^H \leq A^H (K_t^H)^{\alpha^H} (H_t^H N_t^H)^{1-\alpha^H}, \tag{9}$$

where A^C, A^K, $A^H > 0$ denotes the level of total factor productivity in each of the sectors, $1 > \alpha^i > 0$ for $i = C, K, H$, K_t^C denotes physical capital devoted to the production of consumption goods at date t, H_t^C denotes human capital devoted to the production of consumption goods at date t, K_t^K denotes physical capital devoted to the production of capital goods at date t, H_t^K denotes human capital devoted to the production of physical capital at date t, K_t^H denotes physical capital devoted to the production of human capital at date t, and H_t^H denotes human capital devoted to the production of human capital at date t. Obviously, $K_t = K_t^C + K_t^K + K_t^H$ and $H_t = H_t^C + H_t^K + H_t^H$. Note that with the various technologies specified as above, the quantity of hours N and the quality of hours H are assumed to be perfect substitutes in production, in that only the combination NH matters in determining output. The key feature of these technologies that allows this model to generate endogenous steady-state growth is the existence of constant returns to scale in the factors that can be accumulated, K and H. Note, however, that this condition is sufficient, not necessary (see Mulligan and Sala-i-Martin 1993).

I assume a particularly simple government sector. Specifically, I assume that the government balances its budget each period and uses its tax proceeds to make lump-sum transfer payments to the household sector:

$$T_t \leq \tau_t^C C_t + \tau_t^W W_t H_t N_t + \tau_t^R R_t K_t. \tag{10}$$

Note that if I assume that both capital and labor income are taxed at the same rate τ_t^Y (i.e., there is just a generic "income" tax), this expression collapses to

$$T_t \leq \tau_t^C C_t + \tau_t^Y Y_t, \tag{11}$$

where $Y_t = W_t H_t N_t + R_t K_t$.

The representative household takes the paths of factor prices $\{W_t\}_{t=0}^{\infty}$, $\{R_t\}_{t=0}^{\infty}$, relative prices $\{P_t^K\}_{t=0}^{\infty}$, $\{P_t^H\}_{t=0}^{\infty}$, tax rates $\{\tau_t^C\}_{t=0}^{\infty}$, $\{\tau_t^W\}_{t=0}^{\infty}$, $\{\tau_t^R\}_{t=0}^{\infty}$, and transfers $\{T_t\}_{t=0}^{\infty}$ as given in forming an optimal plan for consumption, work effort, and physical and capital accumulation over its expected (infinite) lifetime. The optimality conditions for the household include the following:

$$(12) \qquad \frac{1}{C_t} = \lambda_t(1+\tau_t^C),$$

$$(13) \qquad \theta\frac{N_t}{1-N_t} = \lambda_t(1-\tau_t^W)W_tH_tN_t,$$

$$(14) \qquad \lambda_t P_t^K = \beta\lambda_{t+1}\left[(1-\tau_{t+1}^R)R_{t+1} + P_{t+1}^K(1-\delta^K)\right],$$

$$(15) \qquad \lambda_t P_t^H = \beta\lambda_{t+1}\left[(1-\tau_{t+1}^W)W_{t+1}N_{t+1} + P_{t+1}^H(1-\delta^H)\right],$$

where λ_t denotes the marginal utility of income at date t. The additional conditions are initial conditions (K_0, H_0 given), transversality conditions for the two types of capital and the relevant budget and time constraints.

I combine the first two of these conditions as

$$(16) \qquad \theta\frac{N_t}{1-N_t} = \frac{(1-\tau_t^W)}{(1+\tau_t^C)}\frac{W_tH_tN_t}{C_t} = \frac{(1-\tau_t^W)}{(1+\tau_t^C)}\frac{s_L}{s_C},$$

where s_L denotes the share of labor or wage income in aggregate output and s_C denotes the share of private consumption in aggregate output. This condition determines the consumption–leisure trade-off within each time period, with the terms of the trade-off dictated by the preference parameter θ; the prevailing real wage rate, W_t; the available stock of human capital, H_t; the tax rates on consumption purchases, τ_t^C; and wage income, τ_t^W. Inspection of this condition suggests that there might be an equivalence between taxes on labor income and taxes on consumption spending when tax rates are constant: specifically, a wage income tax rate of τ_t^W is equivalent to a tax on consumption purchases of $\tau_t^C = \tau_t^W/(1+\tau_t^W)$, and a tax on consumption purchases equal to τ_t^C is equivalent to taxing labor income at a $\tau_t^W = \tau_t^C/(1+\tau_t^C)$ rate.[5] However, this equivalence does not hold in this model because the return to human capital accumulation is realized through labor income.

The second pair of equations above governs the optimal accumulation of physical and human capital. The first equation states that along an optimal path, the utility cost of forgoing a unit of consumption to purchase P_t^K units of physical capital must just equal the gain in utility from doing so. An additional unit of capital will generate $(1-\tau_{t+1}^R)R_{t+1}$ additional units of after-tax capital income next period and will have a market value of $P_{t+1}^K(1-\delta^K)$. The return in utility terms is then obtained by multiplying by the marginal utility of consumption next period, λ_{t+1}. To express the return in terms of period t utility, simply multiply by the discount factor, β. The second equation can be interpreted analogously.

Price-taking behavior on the part of firms, along with profit maximization and our assumption that factors can move freely between different productive activities, implies that the real wage will be equated to the marginal product of labor in each sector and the rental rate on physical capital will be equated to the marginal physical product of capital. Thus, we have

$$(17) \qquad \begin{aligned} W_t &= (1-\alpha^C)A^C(Z_t^C)^{\alpha^C} \\ &= (1-\alpha^K)P_t^KA^K(Z_t^K)^{\alpha^K} \\ &= (1-\alpha^H)P_t^HA^H(Z_t^H)^{\alpha^H} \end{aligned}$$

and

$$(18) \qquad \begin{aligned} R_t &= \alpha^CA^C(Z_t^C)^{\alpha^C-1} \\ &= \alpha^KP_t^KA^K(Z_t^K)^{\alpha^K-1} \\ &= \alpha^HP_t^HA^H(Z_t^H)^{\alpha^H-1}, \end{aligned}$$

where $Z_t^i \equiv K_t^i/H_t^iN_t^i$ for $i = C, K, H$.

Balanced growth paths. To keep things tractable, I focus on the behavior of this economy along a balanced growth path. Along such a path, all the aggregate variables (with the exception of hours of work) grow at the same rate, which I denote by γ. Additionally, all tax rates are constant. The balanced growth path is characterized by the following equations:[6]

$$(19) \quad \gamma = \beta((1-\tau^R)\alpha^KA^K(Z^K)^{\alpha^K-1} + (1-\delta^K)) \text{ and}$$

$$(20) \qquad \begin{aligned} \gamma = \beta((1-\tau^W)(1-\alpha^H)A^H(Z^H)^{\alpha^H}N \\ + (1-\delta^H)). \end{aligned}$$

Along the balanced growth path, the aggregate capital–"labor" ratio, Z, is given by

$$(21) \qquad Z = \frac{(1-\tau^R)}{(1-\tau^W)}\frac{\gamma-\beta(1-\delta^H)}{\gamma-\beta(1-\delta^K)}\frac{1-s_L}{s_LN},$$

which, of course, collapses to the familiar $Z = \alpha/(1-\alpha)$ in a one-sector setting with no taxation and inelastic labor supply (see, for example, Barro and Sala-i-Martin 1995).

Welfare. The gain or loss of welfare associated with a particular tax policy change can be calculated as the number ω that satisfies the following equation:[7]

$$(22)\qquad \sum_{t=0}^{\infty}\beta^t\{\log(C_t(\tau^0;.)(1-\omega)) + \theta\log(1-N_t(\tau^0;.))\} = \sum_{t=0}^{\infty}\beta^t\{\log(C_t(\tau^1;.) + \theta\log(1-N_t(\tau^1;.))\},$$

where $C_t(\tau^0;.)$ denotes the level of consumption at date t under the old tax policy and $C_t(\tau^1;.)$ denotes the consumption level under the new tax policy. We can interpret the number ω as the welfare cost of a tax reform. If $\omega > 0$, the representative household is better off under the old tax regime than under the new tax regime and would be willing to pay a fraction of its annual consumption up to ω to remain under the old regime. If $\omega < 0$, the representative household is better off under the new tax regime, and the tax reform has a value equal to the fraction ω of initial consumption. Note that I impose a balanced budget condition on all the tax reform experiments to be conducted below: I assume that any tax cut must be matched by tax increases sufficient to leave the size of the government relative to economic activity unchanged.

If we are willing to focus on comparisons of steady-state balanced growth paths and ignore transitional effects, it is straightforward to show that, with the particular specification of preferences employed above, the number ω is given by the following:

$$(23)\qquad \omega = 1 - \left(\frac{s_C'}{s_C}\right)\left(\frac{\gamma'}{\gamma}\right)^{\beta/(1-\beta)}\left(\frac{1-N'}{1-N}\right)^{\theta}\left(\frac{Y'}{Y}\right),$$

where we use primes " $'$ " to denote the values of different variables after the policy change. Inspection of this expression reveals that any policy change that increases the share of consumption in final output, increases the growth rate, frees time for nonmarket or leisure activities, or increases the scale of activity will be welfare-improving. Note also that this expression suggests that policy changes that have only modest effects on the growth rate can potentially have very large effects on welfare, depending on the value of the discount factor, β. In what follows, we will see that tax reforms that lower the tax rate on capital will typically cause consumption's share of output to fall, but this decline will generally be offset by an increase in the growth rate.

Before proceeding, I need to emphasize that by ignoring transitional effects I obtain estimates of welfare gains or losses associated with tax reforms that are best interpreted as upper bounds on what would occur in reality. Thus, a tax reform that lowers tax rates on, say, physical capital will typically lead to greater investment during the transition to the new balanced growth equilibrium. During the transitional period, consumption will generally be lower and work effort higher, acting to reduce the total welfare improvement from the reform.[8] The numbers reported below are thus best interpreted as showing how much better or worse off the average household would be living in economies characterized by different tax policies.

Calibration. To analyze the quantitative implications of tax reforms in this model, I need to assign values to the various parameters that characterize tastes and technology. The values for the key parameters were chosen to be consistent with some key features of the U.S. economy. The discount factor was set equal to 0.98, which implies a pure rate of time preference of just over 2 percent per annum. The parameter θ was chosen so as to generate a fraction of the time endowment devoted to market activities equal to one-third. The parameters A^C, A^K, A^H were all set equal to 0.34: this generates a steady-state growth rate equal to 1.7 percent per annum in the baseline economy, which is approximately the long-run growth rate of per capita GDP in the United States over the past fifty years. The sectoral classifications used in the model do not map easily into those used in the National Income and Product Accounts, making it difficult to obtain estimates of the elasticities α^C, α^K, α^H using the standard factor share approach. An alternative is to simply assume that the elasticities are about the same in each sector and use the observation that labor typically accounts for about two-thirds of aggregate output. Thus, the parameters α^C, α^K, α^H were set equal to 0.36, 0.35, and 0.37, respectively. The depreciation rate for capital, δ^K, was set equal to 5 percent somewhat arbitrarily. This is lower than the 10 percent rate of depreciation for both physical and human capital assumed by King and Rebelo and employed in much of the real business cycle literature but generates a more realistic steady-state output share of investment in physical capital. Absent any detailed information on the depreciation rate for human capital, I set δ^H equal to 1 percent.[9] This value is a lot lower than the 10 percent value used by King and Rebelo (1990) and Jones, Manuelli, and Rossi (1993) but close to the zero value used by Lucas (1990).

Finally, the steady-state tax rates were set using the estimates reported in Mendoza, Razin, and Tesar (1994). I simply set τ^R, τ^W, and τ^C

Table 1
Some Simple Tax Reforms

	Tax rate on capital	Tax rate on labor	Tax rate on consumption	Share of consumption	Growth rate	Fraction of time worked	Welfare cost
	τ^R	τ^W	τ^C	s_c	$1-\gamma$	N	ω
Baseline	.429	.247	.057	.572	1.7	.330	—
Cut capital income taxes, finance with higher consumption taxes	.215	.247	.201	.477	2.5	.341	–.307
Cut capital income taxes, finance with higher labor income taxes	.215	.366	.057	.575	1.3	.291	.120
Cut capital income taxes, finance with higher consumption and labor income taxes	.215	.312	.122	.530	1.8	.313	–.051
Cut labor income taxes, finance with higher consumption taxes	.429	.124	.205	.477	2.8	.376	–.385
Cut labor income taxes, finance with higher capital income taxes	.646	.124	.057	.596	1.5	.355	.165
Cut labor income taxes, finance with higher consumption and capital income taxes	.517	.124	.145	.522	2.3	.367	–.154
Cut consumption taxes, finance with higher capital income taxes	.471	.247	.029	.592	1.5	.328	.062
Cut consumption taxes, finance with higher labor income taxes	.429	.271	.029	.590	1.5	.322	.059
Cut consumption taxes, finance with higher capital and labor income taxes	.444	.262	.029	.590	1.5	.324	.059

equal to the means of their estimated tax rates on capital, labor, and consumption, which yield values for these parameters equal to 0.429, 0.247, and 0.057, respectively. Note that the estimate for the tax rate on labor is probably a bit on the low side, as it does not take into account the trend toward higher taxation of labor income over the past thirty years.

Tax reforms

Table 1 illustrates the growth and welfare effects of a series of simple (but dramatic) tax reforms in the context of this model. The first row of the table reports the levels of tax rates in the baseline economy, along with the share of consumption, the growth rate, and the fraction of time devoted to market activities. Note that the share of consumption seems rather small, but this is because I am using a measure of output more comprehensive than GDP. Private consumption expenditures account for about two-thirds of U.S. GDP, while in the baseline economy consumer spending accounts for less than 60 percent of aggregate output. The aggregate output concept employed here is broader than GDP in that it includes the output of the human-capital-producing sector. Thus, Barro and Sala-i-Martin (1995) note that GDP fails to include the value of time forgone by students and at least some of the time expended in on-the-job training: they quote estimates that up to half of the value of investment in human capital is excluded from GDP. The remaining nine rows in the table report the consequences of various tax reforms, where the reform in each case consists of a *halving* of the relevant tax rate.

Starting with a reduction in the capital tax rate that is financed by higher consumption taxes, we see that the value of such a reform to the representative household is equal to just under 31 percent of initial consumption. Furthermore, such a reform adds almost a full percentage point to the economy's growth rate (boosting it to 2.5 percent per annum) and is accompanied by an increase in employment. However, the reduction in the tax rate on capital income requires an almost fourfold increase in the tax rate on consumption to maintain budget balance. By contrast, the same reduction in the tax rate on capital income when financed by higher labor income taxes is welfare-reducing: the economy's growth rate slows to 1.3 percent per annum, and the representative household would be willing to pay up to 12 percent of its annual consumption to avoid such a tax reform. If instead the reduction in the capital tax rate is financed by equal increases in consumption and labor income tax rates, the growth rate of the economy rises by a trivial 0.1 of a percent, but the representative household is nevertheless better off, to the tune of about 5.1 percent of initial annual consumption.

The second set of experiments considers the implications of reductions in the tax rate on labor income. A halving of the tax rate on labor income financed by increased taxes on consumption boosts the economy's growth rate to 2.8 percent per annum and has a value to the

representative household equal to just under 40 percent of initial annual consumption! Furthermore, this tax reform requires an increase in the tax rate on consumption expenditures only marginally higher than that required to finance a halving of the tax rate on capital (to 20.5 percent as opposed to 20.1 percent). The same reduction in the tax rate on labor income when financed by higher capital tax rates is welfare-reducing and slows the economy's growth rate from 1.7 percent per annum to 1.5 percent. If the labor income tax cut is financed by equally sized increases in the tax rates on capital income and consumption, I again get higher growth, and the value of the reform to the representative household is equal to 15.4 percent of its initial annual level of consumption.

Finally, the third set of experiments considers the implications of reductions in the tax rate on consumption expenditures financed by higher taxes on either capital or labor income or both. In all cases, the result is to slow the growth rate to 1.5 percent per annum, with a welfare cost associated with the reform equal to about 6 percent of initial consumption.

The results in Table 1 are in some cases quite dramatic and lend support to the idea that a shift in the burden of taxation toward heavier taxation of consumption spending and away from taxation of capital and labor could have beneficial effects on the economy's long-run rate of growth. More generally, the results illustrate the principle that factors that are supplied elastically should receive more favorable tax treatment (from an efficiency perspective) than factors that are supplied inelastically. In the model studied here, the endowment of raw time that each household has is the factor that is supplied inelastically in the long run, whereas the factors that can be accumulated (physical and human capital) are supplied elastically. Taxing the flow of consumption services relatively heavily is in some sense equivalent to taxing the endowment of unimproved time.

Figure 4
Cut Capital Income Tax Rates

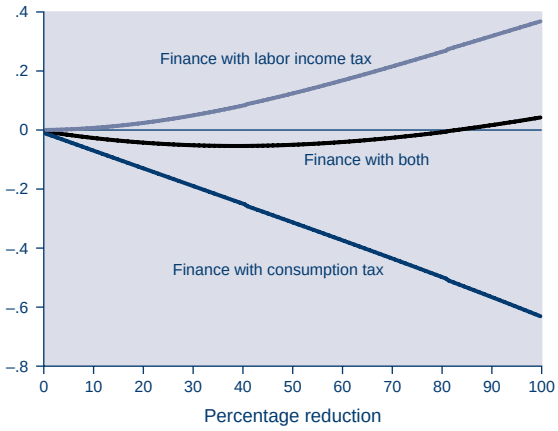
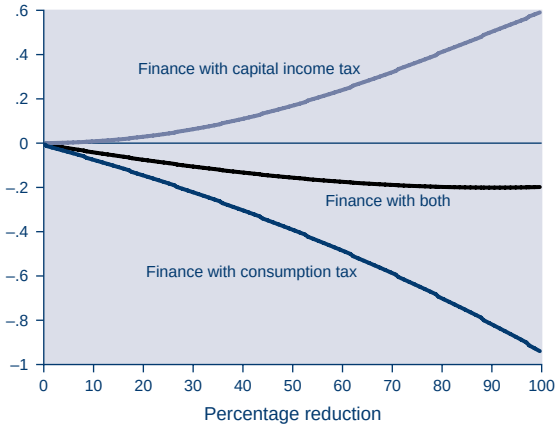


Figure 5
Cut Labor Income Tax Rates



Figures 4 through 7 illustrate the welfare and growth effects of reductions in capital and labor taxes for reductions ranging from zero to complete elimination of the tax. Starting with Figure 4, we see that marginal reductions in the tax rate on capital income that are financed by higher labor income taxes will have a very small effect on welfare, but larger reductions (greater than 10 percent or so) will cause welfare to decline. Complete elimination of the tax on capital income, if financed by higher labor income taxes, would have a welfare cost equal to just under 40 percent of steady-state consumption. By contrast, even relatively modest reductions in capital taxes financed by higher consumption taxes produce welfare gains immediately. Figure 5 shows what happens when we replace labor income taxes with either consumption or capital income taxes. Mirroring what we see in Figure 4, marginal reductions in labor income taxes that are financed by higher capital taxes lead to negligible welfare changes. A reform that completely eliminates the labor income tax and replaces it with higher taxes on capital income has a welfare cost of about 60 percent of steady-state consumption. Again, replacing the labor income tax with a consumption tax produces welfare gains for even relatively small changes.

Figures 6 and 7 show us what happens to the economy's growth rate when we cut capital and labor taxes by progressively larger amounts.

In both cases, the biggest increase in the growth rate is achieved when we replace capital or labor income taxes with consumption taxes. Replacing capital income taxes with higher labor income taxes causes an immediate decline in the growth rate, but marginal changes in labor income taxes that are financed by higher capital income taxes leave the growth rate unchanged.

Conclusions and caveats

This article has presented a preliminary analysis of the welfare and growth effects of some simple tax reforms using a relatively standard three-sector endogenous growth model. I have shown that a shift away from the taxation of capital toward taxation of consumption is potentially welfare-enhancing, and that even larger welfare gains might be obtained by substituting consumption taxes for taxes on labor income.

However, a number of caveats surround these findings. It would be incorrect to interpret my results as indicative of the likely welfare consequences of a real-world tax reform, as I have abstracted from transitional dynamics. Elimination or reduction of taxes on capital income would be followed by a period of higher investment and increased work effort that would tend to reduce (but not offset) the gains from the tax cut. Also, I have focused on a very stylized economy. It is by now well known that the welfare and growth rate effects of reducing or eliminating taxation of capital are very sensitive to some model parameters (particularly the elasticity of substitution between capital and labor in production), and it would be important to carry out a sensitivity analysis of the model before deriving specific policy recommendations.

Finally, I have abstracted from the question of the credibility of the various hypothetical tax reforms. More favorable tax treatment of capital will generally encourage the accumulation of capital, but only if investors believe that the lower tax rates will remain in place. However, once the private sector has built up capital stock in response to lower tax rates, the government faces an incentive to raise the tax rates on capital to confiscatory levels. Investors will realize that the government is likely to face this incentive and so will be wary of betting too much on the persistence of lower capital tax rates into the future.

Figure 6
Cut Capital Income Tax Rates

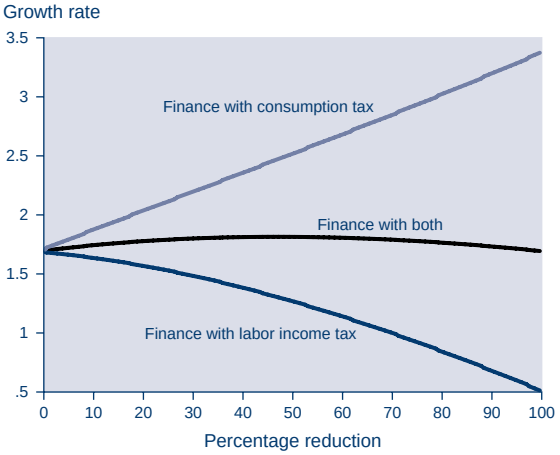
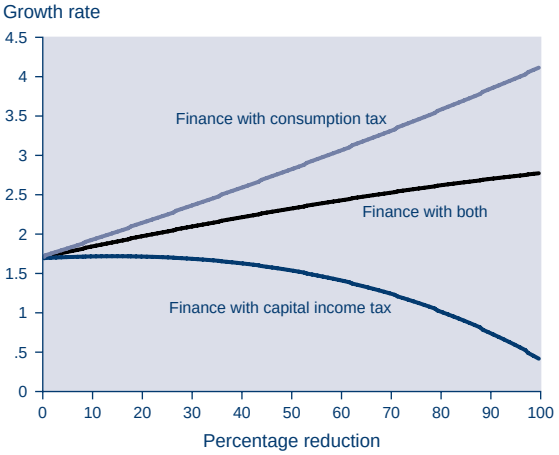


Figure 7
Cut Labor Income Tax Rates



My analysis also has some implications for the Hall–Rabushka flat tax proposal and the national sales tax proposal. Recognizing that human capital is a factor of production that can be accumulated just like physical capital means that, from a tax perspective, human capital ought to receive similar treatment. Thus, under the Hall–Rabushka flat tax proposal, firms would get to expense purchases of capital equipment. My analysis suggests that efficiency would dictate that households should be able to expense investments in human capital. Proposals to replace income taxes with sales taxes typically would exempt business purchases of capital. Again, my analysis suggests that we would also want to exempt from taxation household expenditures on education that augment human capital.

Notes

I thank Greg Huffman for useful comments during the preparation of this article. Jeremy Nalewaik assisted with the data. The reviewers, Evan Koenig and Lori Taylor, provided suggestions that helped clarify key points.

[1] Ramsey, however, does not make this argument.

[2] Operating surplus measures the income earned by tan-

gible and intangible entrepreneurships and other factors of production from their participation in production.

[3] It is also worth noting at this point that this measure of consumption differs in important regards from the figure for private consumption expenditures that is reported in the national income and product accounts (NIPA). The NIPA measure of consumption expenditures includes purchases of durable goods, from which I am abstracting in this analysis. But more importantly, the NIPA measure includes as part of consumption spending on education. Insofar as such expenditures augment the stock of human capital, they ought to be treated as investment expenditures.

[4] Use of the infinitely lived representative household construct precludes consideration of issues of intra- and intergenerational equity.

[5] See, for example, Becsi (1993) for a discussion of such equivalences. It is perhaps worth noting that such equivalences are implicit in various tax reform proposals.

[6] The complete set of equations characterizing the balanced growth path is presented in the appendix.

[7] See, for example, King and Rebelo (1990).

[8] Thus, for example, Lucas (1990) estimates that the welfare gains associated with the elimination of all capital taxes in the United States would equal about 6 percent of annual consumption when transition effects are ignored but less than 1 percent when transitional costs are taken into account.

[9] Jorgenson and Fraumeni (1989) report estimates of investment in human capital in the United States that are at least four times the magnitude of investment in nonhuman or physical capital and estimate that the value of the stock of human capital is over eleven times the value of the stock of physical capital. In the baseline economy studied here, the stock of human capital is about five times the stock of physical capital.

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Appendix
Complete Set of Equations Characterizing the Balanced Growth Path

The full set of equations characterizing the balanced growth path is as follows. From the intertemporal efficiency condition for physical capital accumulation, we have

(A.1) $$\gamma = \beta((1-\tau^R)\alpha^K A^K (Z^K)^{\alpha^K - 1} + (1-\delta^K)).$$

The intertemporal efficiency condition for human capital accumulation is

(A.2) $$\gamma = \beta((1-\tau^W)(1-\alpha^H)A^H (Z^H)^{\alpha^H} N + (1-\delta^H)).$$

Equating rental rates on capital across sectors gives us the conditions

(A.3) $$Z^K = \frac{1-\alpha^C}{1-\alpha^K}\,\frac{\alpha^K}{\alpha^C}\,Z^C \text{ and}$$

(A.4) $$Z^H = \frac{1-\alpha^C}{1-\alpha^H}\,\frac{\alpha^H}{\alpha^C}\,Z^C.$$

From the labor–leisure trade-off we obtain

(A.5) $$\theta\,\frac{N}{(1-N)} = \frac{(1-\tau^W)}{(1+\tau^C)}\,\frac{s_L}{s_C},$$

while the resource constraint for the consumption goods sector can be written as

(A.6) $$s_C = \frac{\phi}{(1-\alpha^C)}\,s_L,$$

From the capital goods sector resource constraint we have

(A.7) $$P^K(\gamma + \delta^K - 1)\left(\frac{K}{Y}\right) = \frac{\phi^K s_L}{1-\alpha^K},$$

and from the human-capital-producing sector we obtain

(A.8) $$P^H(\gamma + \delta^H - 1)\left(\frac{H}{Y}\right) = \frac{\phi^H s_L}{1-\alpha^H}.$$

The economy-wide aggregate resource constraint can be written as

(A.9) $$1 = s_C + P^K(\gamma + \delta^K - 1)\left(\frac{K}{Y}\right) + P^H(\gamma + \delta^H - 1)\left(\frac{H}{Y}\right).$$

By definition,

(A.10) $$1 = \phi^C + \phi^K + \phi^H.$$

The human capital to output ratio is given by

(A.11) $$\left(\frac{H}{Y}\right) = \frac{\beta(1-\alpha^C)(1-\tau^W)}{\gamma - \beta(1-\delta^H)}\,\frac{s_C}{\phi^C}.$$

The physical capital to output ratio is given by

(A.12) $$\left(\frac{K}{Y}\right) = \frac{\beta(1-\alpha^C)(1-\tau^R)}{\gamma - \beta(1-\delta^K)}\,\frac{s_C}{\phi^C}\left(\frac{\alpha^C}{1-\alpha^C}\,\phi^C + \frac{\alpha^K}{1-\alpha^K}\,\phi^K + \frac{\alpha^H}{1-\alpha^H}\,\phi^H\right).$$

Finally, we have the definitions of relative prices:

(A.13) $$P^K = \frac{(1-\alpha^C)}{(1-\alpha^K)}\,\frac{A^C}{A^K}\,\frac{(Z^C)^{\alpha^C}}{(Z^K)^{\alpha^K}} \text{ and}$$

(A.14) $$P^H = \frac{(1-\alpha^C)}{(1-\alpha^H)}\,\frac{A^C}{A^H}\,\frac{(Z^C)^{\alpha^C}}{(Z^H)^{\alpha^H}}.$$

I define s_C, the share of consumption in total output, and $s_L = WHN/Y$, the share of labor compensation in total output. Note that the measure of total output used here is more comprehensive than the usual GDP-type measure: GDP is generally thought to undermeasure investment in human capital. The above is a system of fourteen equations in fourteen unknowns: γ, Z^C, Z^K, Z^H, N, ϕ^C, ϕ^K, ϕ^H, s_C, s_L, (H/Y), (K/Y), P^K, P^H.

Is There a Stable Relationship Between Capacity Utilization and Inflation?

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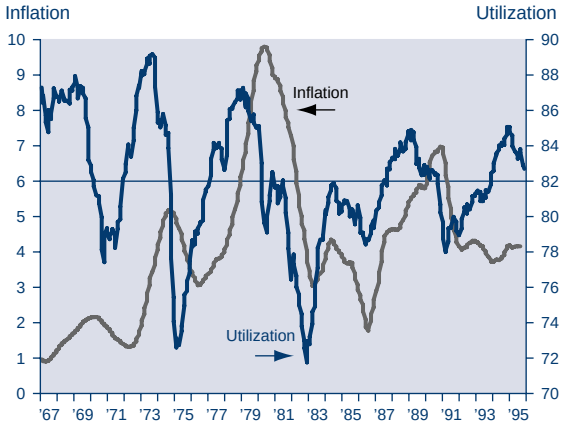
In this article, we examine the predictive power of capacity utilization for inflation, with a focus on whether the forecasting relationship is stable.

During recent years, the failure of monetary aggregates as reliable guides for future inflation has led financial market participants and Federal Reserve policymakers to monitor a broad range of economic statistics. On the real side, analysts increasingly rely on the Phillips curve—the perceived existence of a stable short-run trade-off between inflation and real activity. Most prominently, these analysts focus on the gap between the unemployment rate and the so-called NAIRU, or nonaccelerating inflation rate of unemployment, which is the unemployment rate at which inflation is constant.[1] Similarly, many analysts use the Federal Reserve's industrial capacity utilization rate as an indicator of future inflation pressures.[2] Typically, utilization rates above 82 percent have signaled higher future inflation, brought on by the onset of production bottlenecks and supply shortages. This historical relationship is illustrated in Figure 1, which shows that after capacity utilization rates rose above 82 percent, consumer price inflation accelerated in most instances over the 1967–95 period.

During the past few years, however, the usefulness of both the capacity utilization rate and the unemployment rate as inflation indicators has come under scrutiny. Figure 1 shows that capacity utilization rose above 82 percent at the end of 1993 and that, to date, inflation has remained stable. Likewise, the unemployment rate has been below most estimates of NAIRU for some time.

The response to these recent developments seems to fall into two categories. First, some analysts argue that nothing has changed and that in due time inflation will begin to rise. A second and more varied group of analysts points to several possible developments to explain why inflation has remained stable: demographic factors have lowered NAIRU; increasingly glo-

Figure 1
CPI Inflation and Capacity Utilization



balized labor and capital markets have lessened the importance of U.S. capacity utilization; unmeasured productivity increases have led to a rise in the U.S. economy's growth potential (relevant for gap analyses); and the Federal Reserve mismeasures capacity utilization.

Whereas many studies have examined the link between unemployment and inflation, comparatively fewer have explored the capacity utilization–inflation relationship. In this article, we examine the predictive power of capacity utilization for inflation, with a focus on whether the forecasting relationship is stable. We find evidence that while there was a significant positive relationship between capacity utilization and changes in inflation before 1983, this relationship has substantially weakened since the end of 1982. In fact, after 1982, one can reject the hypothesis that high capacity utilization rates have any predictive power at all for consumer price inflation. The results are similar for changes in producer price inflation, although the deterioration in the relationship is not as severe. In fact, at quarterly and semiannual horizons, there is evidence that capacity utilization after 1982 still has predictive content for changes in producer price inflation.

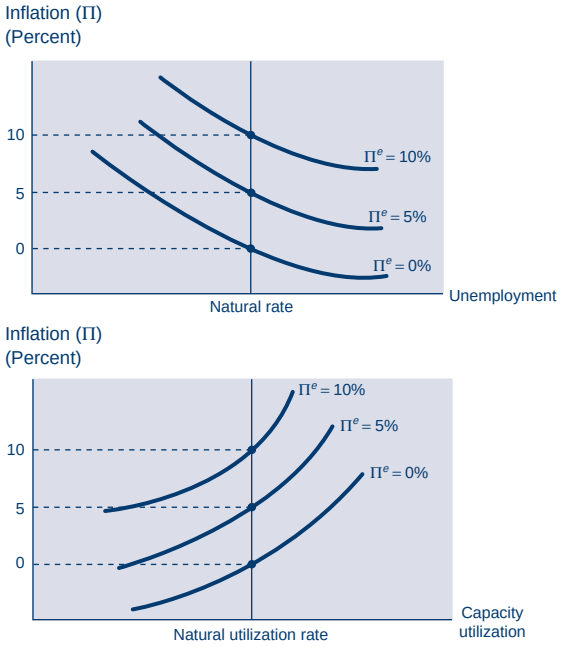
In the first section of this article, we review recent literature concerning the capacity utilization–inflation relationship. In the following section, we examine the empirical evidence as it relates to the capacity utilization–inflation relationship.

Literature review

Although the literature examining the capacity utilization–inflation relationship is relatively sparse, there are several recent studies.[3] A prominent study is Garner (1994), which suggests that the relationship is stable and that capacity utilization currently remains a reliable indicator of future changes in inflation. Specifically, Garner uses simple ordinary least squares regressions (OLS) to show that over different sample periods, the nonaccelerating inflation rate of capacity utilization (NAICU) is roughly constant in the 82-percent range.

In his article, Garner points out the similarity between analyses using the concept of NAIRU and those using the capacity utilization rate. One way to show this similarity is by replacing the unemployment rate with the capacity utilization rate in a simple expectations-augmented Phillips curve model. Expectations-augmented Phillips curves posit a negative trade-off between levels of inflation and unemployment rates for a given level of expected inflation. The top panel of Figure 2 shows several Phillips curves associated

Figure 2
Phillips Curves and the Capacity Utilization–Inflation Relationship



with different levels of expected inflation. The *natural rate* in the top panel of Figure 2 is that level of unemployment at which inflation equals expected inflation.[4] The bottom panel of Figure 2 shows the expectations-augmented Phillips curves that result when the unemployment rate is replaced with the capacity utilization rate. Similarly, the *natural utilization rate* is that rate at which inflation equals expected inflation.

However, most analysts posit a relationship between changes in capacity utilization and inflation. To derive such a relationship, an extra assumption must be made about the formation of inflation expectations—specifically, that the next period's expected inflation rate (Π^e) is equal to a weighted average of lagged inflation rates, with the weights summing to one.[5] Under this

Figure 3
Critical Utilization Thresholds in Short-Run Phillips Curve Models

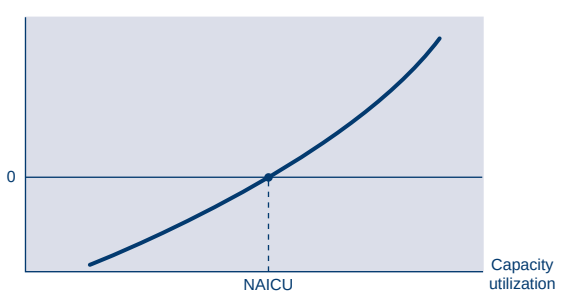


Table 1
Linear Regression Results
1967:1–96:2 Sample

	R^2	Constant	Coefficient on CU_{-1}	Significance of lagged inflation	NAICU (Percent)
CPI					
Monthly	.35	−22.7	.28	(.000)	81.0
		(.00)	(.00)		
Quarterly	.32	−25.3	.31	(.000)	82.6
		(.00)	(.00)		
Semiannual	.18	−30.8	.38	(.021)	81.7
		(.01)	(.01)		
PPI					
Monthly	.43	−37.8	.46	(.000)	82.2
		(.00)	(.00)		
Quarterly	.50	−45.3	.55	(.000)	82.0
		(.01)	(.01)		
Semiannual	.36	−52.0	.63	(.000)	82.0
		(.00)	(.00)		

p values in parentheses

assumption, the result is a positive long-run relationship between changes in capacity utilization and inflation, depicted in Figure 3.[6] Of course, if the expectations assumption does not hold, then at the least there may be instability in the relationship.[7]

Other studies of the capacity utilization-inflation relationship find mixed evidence on the issue of stability.[8] Franz and Gordon (1993) find that U.S. inflation depends more closely on the capacity utilization rate than on the unemployment rate. However, their only stability analysis is a comparison of the 1962–72 period with the 1973–90 period, which concludes stability cannot be rejected. Cecchetti (1995), in a paper that examines a number of inflation indicators, finds evidence that capacity utilization adds significant information to out-of-sample forecasts of inflation before 1982, but this information disappears after 1982.

The next section explores the stability of the capacity utilization–inflation relationship.

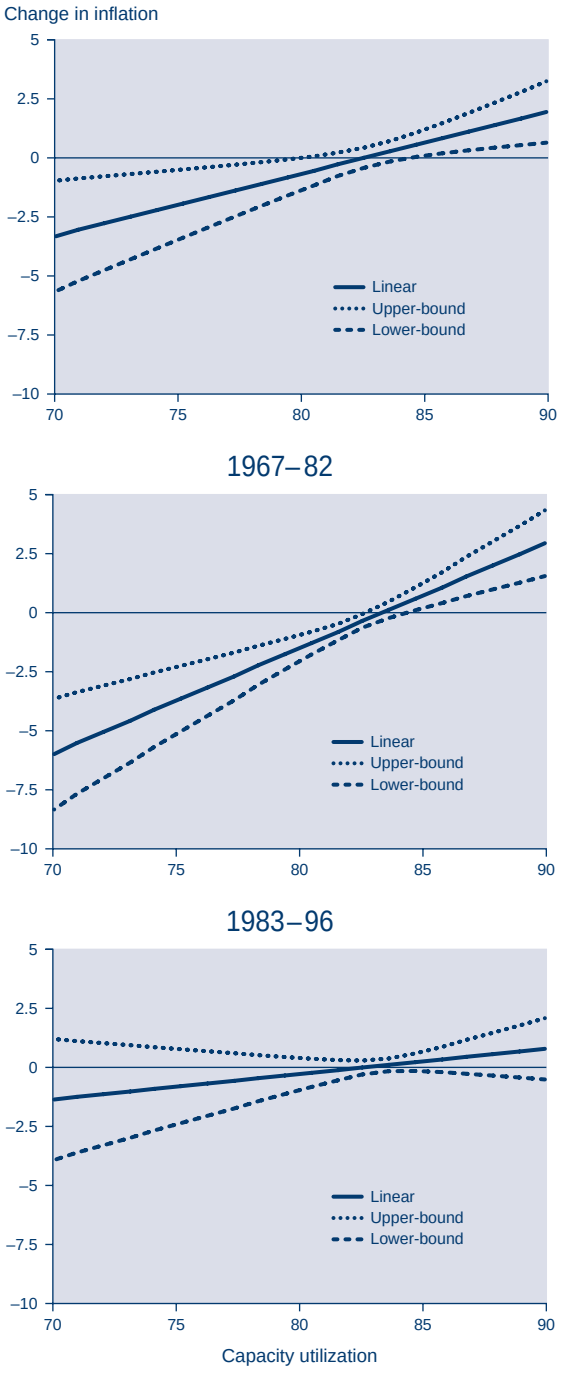
Empirical results

A standard OLS model. To examine more precisely the relationship between capacity utilization rates and changes in inflation, we run a series of regressions of the form

$$(1) \qquad \Delta\Pi_t = A + B\,CU_{t-1} + \sum_{i=1}^{n} C_i \Delta\Pi_{t-i} + u_t,$$

where $\Delta\Pi_t$ is the change in inflation from period t to period $t-1$; CU is the industrial capacity utilization rate; u is an error term; and A_i, B_i, and C_i are parameters to be estimated.[9] Essentially, equation 1 is an in-sample forecasting equation that uses lagged information to predict future changes in inflation rates.[10] To examine changes in inflation at horizons longer than one month, we estimate equation 1 using not only monthly data, but also quarterly and semiannual data that are constructed from the monthly data.[11] The data cover the sample period January 1967 through February 1996. For our measures of inflation, we use the consumer price index (CPI) and the producer price index (PPI).[12] Industrial capacity utilization may be more closely related

Figure 4
Regression Models: CPI (monthly), 1967–96



for PPI inflation because the PPI includes only goods prices, whereas the CPI also includes the prices of services.

Table 1 shows both the CPI and PPI results. For the CPI results, the model explains roughly one-third of the overall variation of changes in inflation, and there is no evidence of serial correlation in the error terms. The lag of capacity utilization is very significant with a positive sign, which indicates that a high capacity utilization rate leads to rising inflation. The magnitude of the coefficient on capacity utilization varies with the data used. For example, with the monthly data, a one-percentage point increase in the utilization rate leads to a 0.28-percentage point increase in inflation at an annualized rate. The NAICU is near 82 percent for all three models. In other words, above 82 percent, inflation is rising, and below 82 percent, inflation is falling. These results are consistent with Garner (1994), who finds NAICUs in the 82-percent range.

For the PPI results, the explanatory power of the models is higher than for the CPI models. Depending on the data, the adjusted R^2s range from 0.36 to 0.50. The coefficients on capacity utilization are positive and significant, and larger than those in the CPI models. For the monthly data, a one-percentage point increase in the utilization rate leads to a 0.46-percentage point increase in inflation at an annualized rate. Similar to the CPI results, the NAICUs are in the 82-percent range for all three models.

In general, these results are consistent with previous work that finds a positive and significant relationship between capacity utilization and future changes in inflation.

Stability of the utilization–inflation relationship. On the basis of Figure 1 and because of recent assertions that the relationship between the change in capacity utilization and inflation has changed, we test for a break in the relationship by using January 1983 as the potential breakpoint.[13] The data indicate significant parameter instability.[14] Therefore, we reestimate equation 1 using the two separate subsamples. Table 2 shows the CPI results, and Table 3 shows the PPI results. For the CPI results, the NAICUs remain in the 82-percent range for both sample periods, which is consistent with Garner's (1994) results. However, there are substantial differences across the two samples in other aspects of the results. First, the explanatory power of the model is reduced for the post-1982 period, as evidenced by the much smaller adjusted R^2s. Moreover, the marginal significance levels (p values) for capacity utilization indicate that utilization is no longer significant for any of the models in the post-1982 period. Also, the point estimates of the coefficients on capacity utilization are much smaller compared with the pre-1983 estimates.[15] Figure 4 shows the trade-offs between changes in CPI inflation and capacity utilization for the monthly

Table 2
Sample Instability: Linear Regressions

CPI

1967:1–82:12 Sample

	R^2	Constant	Coefficient on CU_{-1}	Significance of lagged inflation	NAICU (Percent)
Monthly	.45	–38.9	.47	(.000)	82.7
		(.00)	(.00)		
Quarterly	.59	–43.7	.53	(.000)	83.2
		(.00)	(.00)		
Semiannual	.57	–37.6	.45	(.021)	82.8
		(.00)	(.01)		

1983:1–96:2 Sample

	R^2	Constant	Coefficient on CU_{-1}	Significance of lagged inflation	NAICU (Percent)
Monthly	.28	–9.3	.11	(.000)	82.1
		(.27)	(.26)		
Quarterly	.35	–3.8	.05	(.000)	83.1
		(.64)	(.65)		
Semiannual	.09	–8.7	.11	(.010)	81.4
		(.45)	(.44)		

p values in parentheses

Table 3
Sample Instability: Linear Regressions

PPI

1967:1–82:12 Sample

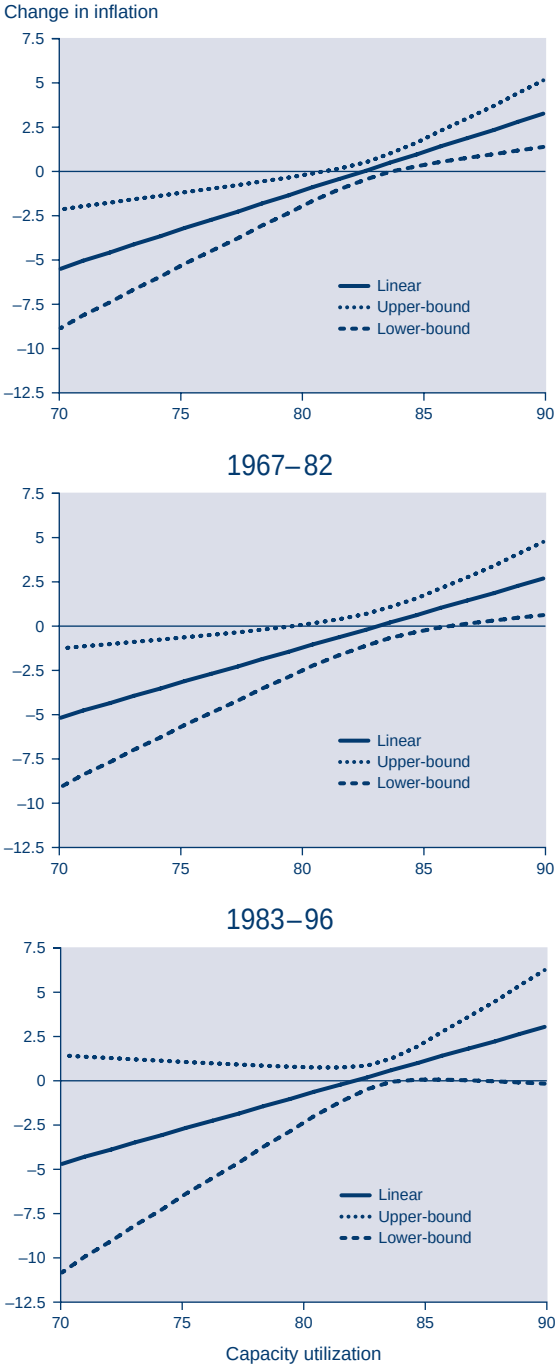
	R^2	Constant	Coefficient on CU_{-1}	Significance of lagged inflation	NAICU (Percent)
Monthly	.51	–34.2	.41	(.000)	82.5
		(.01)	(.01)		
Quarterly	.41	–54.5	.66	(.000)	83.0
		(.01)	(.01)		
Semiannual	.31	–61.5	.74	(.004)	82.9
		(.00)	(.00)		

1983:1–96:2 Sample

	R^2	Constant	Coefficient on CU_{-1}	Significance of lagged inflation	NAICU (Percent)
Monthly	.31	–33.2	.41	(.000)	81.6
		(.10)	(.09)		
Quarterly	.58	–35.9	.44	(.000)	80.2
		(.03)	(.03)		
Semiannual	.45	–56.6	.70	(.000)	81.4
		(.00)	(.00)		

p values in parentheses

Figure 5
Regression Models: PPI (monthly), 1967–96

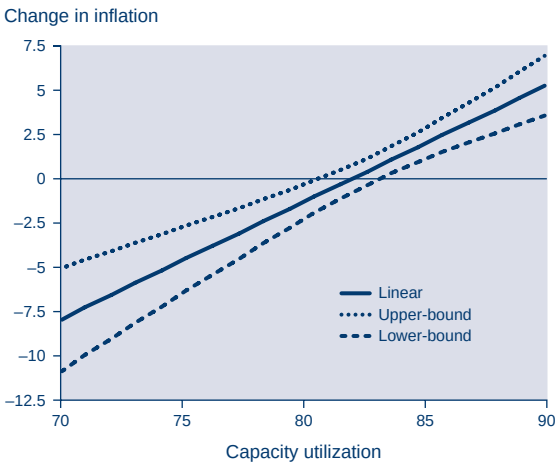


model estimated over the entire sample, as well as the two sub-samples.[16] Not only does the trade-off flatten during the later sample period, but our 95-percent confidence bands for the NAICU have widened to the point that any capacity utilization rate is consistent with no change in inflation.[17] In other words, the confidence bands encompass the zero change in inflation line across the utilization range that the U.S. economy has experienced.[18]

In Table 3, the differences in PPI results across the two samples are not as great as those for CPI. For the quarterly and semiannual data, the adjusted R^2s are actually higher in the later sample period. Also, the point estimates of the coefficient on capacity utilization are in the same range for both sample periods. Moreover, the NAICUs fall in the same range across the two subsamples and, if anything, are lower in the later period. However, Figure 5 shows that the lower confidence levels about the point estimates of the coefficient on utilization and the constant term imply reduced confidence about our estimate of the NAICU in the later sample period. Similar to the CPI results in Figure 4, for the monthly and quarterly models, the confidence bands for the NAICU in the 1983–96 period indicate reduced confidence about the utilization rate at which PPI inflation begins to accelerate. However, for the semiannual data (*Figure 6*), the confidence bands remain relatively tight in the 1983–96 period, indicating that PPI inflation begins to accelerate six months after the utilization rate rises above the 80- to 82-percent range.

Overall, the conclusions from the subsample results are quite strong. For changes in CPI inflation during the 1983–96 period, there is no evidence that capacity utilization provides any useful information about future changes in inflation. In fact, at the 95-percent confidence level, any capacity utilization rate is consistent with no change in inflation. For monthly changes in PPI inflation, the results are similar to the CPI results. However, for the semiannual data, capacity utilization does have significant information for future changes in PPI inflation, and the 95-percent confidence range for the NAICU

Figure 6
Regression Models: PPI (semi), 1983–96



is estimated to be between 80 and 82 percent. Results for quarterly PPI data are intermediate.

Conclusions and Discussion

During recent years, the reliability of the unemployment and capacity utilization rates as future inflation indicators has come under question. Because the usefulness of these indicators is predicated on a stable short-run trade-off between real activity and inflation, this scrutiny has entailed a reexamination of the Phillips curve. Although much of the literature has focused on the unemployment–inflation relationship, in this article we have examined the relationship between capacity utilization and inflation.

We find evidence that although capacity utilization had significant predictive power for changes in consumer price inflation before 1983, this relationship has substantially weakened since the end of 1982. In fact, after 1982 there is no evidence that high capacity utilization rates forecast increases in consumer price inflation. For changes in producer price inflation, we find a significant positive predictive relationship before 1983 that is even stronger than the pre-1983 capacity utilization–consumer price inflation relationship. Additionally, although there is some deterioration in the relationship between changes in producer price inflation and capacity utilization after 1982, there is still evidence of a significant positive predictive relationship, especially at forecast horizons of six months.

There are a number of possible explanations for the deterioration in the ability of capacity utilization to forecast changes in inflation, including potential mismeasurement of capacity utilization and an increasingly global economy. Another potential explanation for the deterioration in the forecasting relationship is that the conduct of monetary policy has changed (Cecchetti 1995). In fact, many analysts have argued that the Federal Reserve has been more forward-looking and quicker to bring inflation pressures under control during the 1980s and 1990s than during the late 1960s and 1970s (Balke and Emery 1994). If the Federal Reserve is now quicker to tighten policy in response to such indicators as rising capacity utilization rates, these indicators may no longer be followed by rising inflation, simply because the Federal Reserve has already tightened policy and brought inflation pressures under control. Importantly, however, the policy implication is not that the Federal Reserve should stop monitoring the utilization rate. After all, it is because the Federal Reserve has monitored the utilization rate as an indicator of rising inflation *pressures* that inflation has remained relatively stable. In any case, future research should focus on establishing the validity of the monetary policy explanation versus others that are put forward.

Notes

We thank Nathan Balke, Carl Bonham, John Duca, Joseph Haslag, Evan Koenig, Charles Steindel, and an anonymous referee at the Board of Governors for helpful comments and suggestions.

1 *Output gap* analyses similarly reflect the belief in a stable short-run Phillips curve. In gap analysis, current output above estimated potential output signals rising inflation.

2 For examples, see the Board of Governors (1994), Citibank (1996 a, b, and c), Cooper and Madigan (1996 a and b), and Merrill Lynch (1996).

3 The recent literature examining the unemployment–inflation relationship includes Duca (forthcoming), Fuhrer (1995), King, Stock, and Watson (1995), Weiner (1993), and Koenig and Wynne (1994).

4 The natural rate of unemployment is also considered the long-run rate of unemployment to which the economy tends over time.

5 To see that this assumption is necessary, consider an empirical Phillips curve model in which a distributed lag of past inflation proxies for expected inflation:

$$\Pi_t = K + B\,U_t + \sum_{i=1}^{n} \lambda_i \Pi_{t-i} \qquad \text{(as in Figure 2)},$$

where Π and U are the level of inflation and the unemployment rate and $E(\Pi_t) = \sum_{i=1}^{n} \lambda_i \Pi_{t-i}$. In the special case where $\sum_{i=1}^{n} \lambda_i = 1$, then

$$\Pi_t - \Pi_{t-1} = K + B\,U_t + \sum_{i=1}^{n-1} u_i(\Pi_{t-i} - \Pi_{t-i-1}),$$

where $u_i = \left(\sum_{j=1}^{i} \lambda_j\right) - 1$. In the long run, this equation has the form of Figure 3 when lagged changes in inflation equal zero.

6 The NAIRU and NAICU are special cases of the natural rates where the expectations assumption described above is invoked.

7 Basically, the failure of this assumption is the Lucas critique.

8 Finn (1995) is another study that finds a positive relationship between capacity utilization and inflation. However, the issue of stability is not addressed.

9 Equation 1 includes two dummy variables to control for the Nixon wage and price controls. It also includes lags of changes in relative petroleum price inflation to control for energy price shocks. One dummy variable equals one for the year 1972, and the other equals one for the years 1974–75. The relative price of petroleum inflation is from the producer price index.

10 Cointegration is not a concern, as augmented Dickey–

Fuller tests indicate that the change in inflation and capacity utilization rates are stationary. The Akaike information criterion (AIC) and the Schwartz information criterion (SIC) indicate that one year of lagged changes in inflation and energy price inflation is sufficient. The results are qualitatively unaffected when only six months of lagged information is used. Only one lag of the capacity utilization rate is included because additional lags are statistically insignificant.

[11] Policymakers and financial market participants are more concerned with trends in inflation rather than the more noisy monthly changes in inflation. The quarterly and semiannual data are constructed from the end-of-period monthly data.

[12] There are no qualitative differences when we run these regressions using core-CPI inflation, which excludes food and energy prices.

[13] Other reasons for choosing January 1983 include a change in the Federal Reserve operating procedures at this time and a change in the behavior of inflation (Emery 1994). The qualitative nature of the results is robust with respect to other dates near the end of 1982.

[14] We use a likelihood ratio test to examine for instability in any or all of the coefficients.

[15] However, when all of the coefficients in the model are allowed to vary across the two samples, the data are not strong enough to reject the hypothesis that the coefficients on lagged capacity utilization are equal in both samples at the 95-percent confidence level.

[16] The trade-off is constructed from the coefficient estimate on the constant term and the capacity utilization term, setting all the other coefficients equal to zero.

[17] The confidence bands reflect only the uncertainty associated with coefficient estimates on the constant term and the capacity utilization term, not the uncertainty reflected in the error term of the regression.

[18] The figures are qualitatively similar for the quarterly and semiannual data.

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Liberalization, Privatization, And Crash: Mexico's Banking System in the 1990s

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This article details the events that precipitated and followed Mexico's financial crisis and examines how the problems took shape.

Although the Mexican economy has been growing since the third quarter of 1995, the banking sector remains in serious financial straits whose resolution, the government estimates, will ultimately absorb the equivalent of 8 percent of current annual gross domestic product (GDP). Indeed, despite Mexico's recovery, domestic banking fragility strains Mexico's ability to finance a deepening and diversifying of this recovery among smaller and mid-sized firms, which lack large firms' access to international capital markets.

This article details the events that precipitated and followed Mexico's financial crisis and examines how the problems took shape. Although Mexico's banking crisis is closely related to the December 1994 peso devaluation, its foundations were laid much earlier. In fact, there is much to suggest that Mexico's devaluation occurred in part because the optimal policies for resolving an incipient banking crisis contradicted the requirements for maintaining a pegged exchange rate.

Very recently, a literature has developed that not only addresses the banking crisis but also deals with Mexico's difficulties in a microeconomic financial industry context. Despite its Mexican focus, this literature has much to say about microeconomic problems that can ensue in the wake of any financial liberalization.

According to this literature, monitoring potential problem loans is especially difficult when—as in Mexico in the early 1990s—euphoric investor behavior and a rising economy make identifying risky borrowers more difficult. When foreign capital departs, what always had been risky behavior suddenly becomes more obvious. This monitoring problem, which not only regulators but the banks themselves face, helps explain the suddenness of some banking crises—that is, when anything goes wrong, everything does (Hausmann and Gavin 1995).

An important backdrop for this monitoring problem in Mexico—and the attendant inrush of capital and its subsequent outflow—was the behavior of its banks in the wake of financial liberalization. For Mexican banks, Gruben and McComb (1996) find—as Shaffer (1993) finds for Canadian banks in the wake of liberalization in the 1980s—behavior consistent with a postderegulation struggle for market share. In these struggles, a typical bank extends financial services more aggressively in the short run than it would in the long run. It may lend so expansively in the short and medium run that marginal costs exceed marginal revenue. The bank may be encouraged in this by the apparently strong balance sheets of borrowers for whom what may appear a permanent improvement in for-

tunes ultimately turns out to have been temporary (Hausmann and Gavin 1995).

In such periods, not one but a collection of phenomena may conspire to send illusory messages. Banks may engage in herd behavior as lenders send unrealistically positive signals about the economy to one another and as the euphoric flow of foreign capital into the nation's financial markets (common following a liberalization) temporarily sends signals that some may wrongly take to be permanent (Gonzalez-Hermosillo, Pazarbaşioğlu, and Billings 1996; McKinnon and Pill 1996; Ostos Jaye 1996).

What distinguishes more recent literature on this topic from what appeared in the past is that more of the recent literature details this behavior empirically. This allows the statistical characterization of expansive behavior as it happens, in contrast to the more traditional verbal descriptions of what may be easy to identify when the crash comes but is hard to prove convincingly beforehand.

To put Mexico's recent experience in context, we detail the government's previous, financial repression approach to regulation, examine the Mexican financial system of the 1980s, and consider the privatization of the early 1990s and its aftermath. We characterize the banking crisis as it began to materialize before the devaluation of December 1994 and follow with the denouement of 1995, which included programs that not only preserved depositors' assets (the banks' liabilities) but also, strange to relate, the assets of the banks' stockholders.

The nationalization of Mexico's commercial banks

To elucidate the causes and effects of the Mexican financial system's volatile trajectory, we open with the end of the Lopez Portillo administration in 1982, the first year of real economic decline since 1932. Faced with increasing pressure against the peso and attendant capital flight, the administration forgot the real reasons capital flees a country, blamed the banks, and nationalized them. To make sure the banks stayed that way, Lopez Portillo incorporated the nationalization into the constitution.

The government's new prisoner was an ill one. The banks were suffering the effects of falling oil prices, bursts of exchange rate instability, and, ultimately, regulatory oversight problems, evidenced in retrospect by extensive self-lending. Mexico recapitalized the banks and began to consolidate them. Of the fifty-eight originally nationalized, only eighteen remained by 1990 (Banco de México 1992).

Broadening and deepening the financial markets

A financial crisis had preceded the bank nationalizations in 1982. The problems included an accumulation of government debt Mexico was hard put to pay. For years thereafter, government domestic borrowing crowded out private borrowing. The government absorbed domestic credit by decree, imposing heavy reserve requirements on the banking system and allowing them to be fulfilled only by the purchase of government debt. In 1986, for example, more than 60 percent of net bank credit flowed to the government.

Crowding out was only part of the banking system's problem, however. Until the late 1980s, Mexico was a classic case of general financial repression.[1] Not only did the government force banks to lend to it, but it maintained interest rate ceilings on bank assets and liabilities and dictated lending quotas to what it deemed high-priority economic sectors. (See the box entitled "Financial Repression.")

One of the key events in Mexico's financial development of the 1980s was the government's move to facilitate an increase in nonbank financial intermediation. This move served as a first step in both ending financial repression and increasing the system's ability to capture national assets for intermediation. When Miguel de la Madrid Hurtado replaced Jose Lopez Portillo as president in 1982, the new administration would not privatize the newly public banks; nationalized banking was protected by the constitution.

But perhaps everything those banks did was not really banking. In 1984, the de la Madrid administration began to sell off the brokerage houses, insurance companies, and other bank operations that did not take deposits and make loans. Between 1982 and 1988, nonbank financial institutions' assets rose from 9.1 percent of total financial system assets to 32.1 percent.

Also driving nonbank financial institutions' growth was the rapid expansion of Mexico's securities market. This expansion in large part reflected the increased issuance of *cetes*—short-term government debt comparable to U.S. Treasury bills. The point was to create a separate market for public debt so as to wean the government from the banks. Mexico had begun to issue these instruments in 1978, but it was not until the de la Madrid administration that they became major funding sources for the government.

By the late 1980s, the Mexican money market had become liquid and sophisticated. As a result, by the beginning of the 1990s,

the Mexican government no longer relied on commercial bank financing. The 1988–89 biennium was among the most significant for financial liberalization in Mexico and for attendant broadening and deepening of financial markets there. Important events included not only the development of the money market but also the freeing of interest rates on bank assets and liabilities, the elimination of priority lending quotas, and, ultimately, the phaseout of both reserve requirements and liquidity coefficients. Moreover, banks were given greater opportunity to compete with brokerage houses, which had been taking market share from the banks at a rapid rate.

In 1990, more options became available. Under Carlos Salinas de Gortari, who in 1988 succeeded de la Madrid as president, the Mexican congress amended the constitution to permit the sale of the nationalized banks, although only to Mexicans. Soon after, a new Financial Groups Law was passed, heading the banks back toward the universal banking system to which they had been moving before the 1982 nationalization. Under universal banking—common in Europe but illegal in the United States—the same holding company may control an insurance company, a bank, a brokerage house, a leasing company, a factoring company, a bonding company, a mutual funds management company, a currency exchange broker, and a warehousing company.

Reprivatizing the banks

The government sold its eighteen banks in fourteen months—June 1991 through July 1992—at the extraordinarily high average price-to-book-value ratio of 3.49. Mexico used the proceeds to pay down the public debt left over from the financial crisis of the 1980s. Both anecdotal and econometric evidence (Lopez de Silanes and Zamarripa 1995) suggests that the buyers—financial groups and brokerage houses mostly—may have paid those high prices because they expected only very limited competition between banks. With eighteen newly privatized banks, plus two others that for particular reasons had never been nationalized, there were only twenty commercial banks taking deposits and lending in Mexico. Even among these twenty, market power was highly concentrated. At the time the last of the banks was privatized, the three largest accounted for about three-fifths of all Mexican bank assets. Moreover, profits were high. In 1992, when the government sold the last of its commercial banks, the net return on assets for Mexican banks was approximately 1.45 percent, versus 0.91 percent for U.S. banks.

The new owners managed to mark loan rates up significantly above their cost of funds. Over the first five months of 1991, when the eighteen banks were still public, the spread between average cost of funds and average lending rate ranged from 5.31 percentage points to 6.29. During the last five months of 1992, when the eighteen banks were all private, spreads ranged from 8.09 percentage points to 10.69—even though inflation rates were lower in 1992 than in 1991. The spreads widened because banks paid depositors lower interest rates in late 1992 than in early 1991, while the interest rates they charged borrowers were higher than they had been.

By the date of the privatizations, some bank performance measures had already improved compared with the middle and late 1980s.

Financial Repression

To understand the implications of Mexican financial liberalization, it is useful to understand the implications of what occurred before liberalization—and to understand them in a general sense. The term for not only Mexico's but many developing countries' historical approach to dealing with financial institutions is *financial repression*. It is easy to understand why.

Developing countries have historically been more aggressive than industrialized countries in their detailed control of banks. In general, governments in both developed and developing countries attempt to pursue prudential regulation of their banking systems and may impose controls on the banks' exchange rate exposure. But developing countries have by tradition more actively controlled banks' interest rates on deposits, how much and to which industrial sectors the banks lent, and bank lending rates.

Developing countries, and certainly Mexico, traditionally have imposed far higher reserve requirements than developed countries. The reason appears to have little to do with the common textbook discussions, in which required reserve ratios are policy instruments used to restrict monetary growth.[1] The purpose has typically been to capture the resources of the banking system by force. Historically, other capital markets were not adequately developed to fund governments at the level to which they wished to become accustomed. The reserve requirements could be met by the purchase of government, but not private, debt.[2]

Similarly, in Mexico and in many other developing countries, ceilings on interest rates paid on deposits and for loans played an important role. Low deposit rates have the advantage of allowing banks to charge low loan rates, whereas loan rate ceilings force them to do so. More generally, Mexican policy for a long time officially directed bank funding to certain prescribed economic sectors—the government, of course, being one of them.

The problem with financial repression, of course, is that the public has many options when it wants to purchase assets. Many of these—the purchase of inflation hedges such as land, gold, and jewelry—are not very efficient forms of financial intermediation. That is, they are not very effective at channeling investment funds from those with a surplus to those with productive ideas but a funding deficit. High financial repression typically means that the banking system manages to capture only a relatively small portion of public assets. The ultimate social cost can be a lack of investment.

[1] Fry (1995) notes that over the period 1978–87, the ratio of bank reserves to bank deposits averaged 21.2 percent in ninety-one developing countries, compared with 7.1 percent in nineteen industrialized countries, meaning that the ratio of reserves to deposits was three times as high in the developing countries. On the issue of whether developing countries use high reserve requirements as instruments of restrictive monetary policy, Fry also notes that cross-country comparisons indicate high simple correlations between monetary growth or inflation and the ratio of bank reserves to deposits.

[2] Indeed, because the resources of banking systems are often easier for governments to attach in this way than other resources of financial systems, governments in developing countries often use rules, regulations, and charges to inhibit the development of nonbank finance.

For example, the banking system's ability to capture the nation's assets for intermediation had increased markedly. Despite an increasing ability not only to attract funds but to generate profits, low efficiency persisted. At the end of 1991, a common measure of bank efficiency—the noninterest expense to total assets ratio—was 5.3 in Mexico, compared with 3.6 percent in the United States.

Marketing seems not to have received much attention either. In 1991, Mexico had one bank branch for about every 18,000 people. In the United States, the number was about one branch per 4,000 and in Europe, about one for every 2,000.

These factors probably help explain why financial penetration, a measure of the degree to which savings are channeled through the financial system to provide financing for investment, was also low in Mexico. As measured by M4/GDP (where M4 is currency, checking accounts and other short-term deposits, bankers acceptances, long-term bank deposits, and government bonds held by the public), financial penetration grew markedly in the late 1980s and early 1990s. Nevertheless, by 1992 it was still only 46.1 percent, compared with 97 percent in Canada, 93 percent in the United States, and 71 percent in Italy.[2]

Increasing financial market competitiveness

If the high price-to-book ratios they paid meant buyers of Mexico's commercial banks in 1991 and 1992 expected competitiveness to continue at these low levels, 1993 would be a surprise. After cutting the number of banks in the 1980s, Mexico began to open its markets to new domestic entrants in 1993. By 1994, a total of thirty-five Mexican-owned banks (including the eighteen privatized in 1991–92) had charters.

The wave of domestic bank charters that began to roll in 1993 was followed by another, of foreign applicants, in 1994. Before 1994, the only foreign bank chartered to operate as a deposit-taking and lending institution in Mexico in the 1990s was Citibank. But in 1994, new bank regulations attendant to the implementation of the North American Free Trade Agreement (NAFTA) allowed foreign-owned banks to operate in Mexico, although market share maxima would greatly restrict their opportunities.

Pressures on the system: Exogenous

The prospect of increasing competition, together with the consolidation of organizational changes, led to noticeable alterations in Mexico's commercial banking system. Between December 1991 and December 1994, the number of bank branches grew by one-eighth, while total bank employment slipped and then fell hard. Measures of efficiency, including the ratio of noninterest expenses as a share of assets, edged downward. Although improvement was slow, it still was improvement.

But other pressures began to cause difficulties for the banking system. As part of Mexico's efforts toward productive efficiency and low inflation in the late 1980s, the country had not only lowered trade barriers but had also followed an exchange-rate-based inflation stabilization policy. The government fixed the exchange rate during 1988. The next year, Mexico commenced a crawling-peg regime in which the peso's rate of depreciation against the dollar was lower than the differential between the two countries' inflation rates.

The resulting increase in the real exchange rate, together with the trade apertures that had begun in the late 1980s, caused international competition that discouraged producers of tradeable products from raising their prices. The nontradeable products sectors, including real estate and construction-related industries together with various service producers, were less sensitive to such discipline. By definition, nontradeable products are those that have little if any foreign competition. But nontradeable products are typically among the inputs tradeables producers use to make their products. When nontradeables producers raised their prices, they imposed a squeeze between costs to and selling prices of tradeable goods producers. The squeeze on these producers soon began to have implications for the banks that had lent them money.

Another important bank-related detail of Mexico's economic policy was related to the increasingly negative balance of trade. To maintain dollar reserves to defend the exchange rate, and to create capital inflows that would offset the outflows of funds to buy imports, Mexico held interest rates relatively high. Real interest rates rose during 1992 and 1993, making it more difficult for borrowers to repay their typically variable-rate loans.

Pressures on the system: Endogenous

In addition to pressures from outside sources, the banking system incurred self-inflicted wounds. When it was privatized in 1991–92, a widespread concern was that the system was not only not very competitive by world standards but that years could pass before

it would be. While privatization was expected to ameliorate some measures of inefficiency, Mansell Carstens (1993a) argues that among the reasons the spread between banks' interest rates on loans and their cost of funds could be expected to remain high for years is the high degree of oligopoly power in the provision of bank services.[3]

Gavito Mohar, Sánchez Garcia, and Trigueros Legarreta (1992) express similar concern about the anticompetitive implications of concentration in the Mexican commercial banking system, while Gavito and Trigueros (1993) argue that "some additional measures would be useful to induce greater competition." Gruben and Welch (1996) suggest that not only is Mexico's banking system not very competitive but that the high price-to-book ratios paid by the banks' new owners signal that they expected banking's industrial organization to remain relatively uncompetitive.

In sum, while Mexico's bank privatizations and the financial liberalizations that preceded, paralleled, and followed them were seen as offering greater opportunities for competitiveness, the high levels of bank concentration and the wide spreads between banks' cost of funds and interest rates on loans were taken to mean that years might pass before these opportunities were seized. NAFTA might ultimately allow greater competitive pressures in Mexico; so might the decrease in restrictions on starting new banks (Gavito and Trigueros 1993). All of this would take time, possibly much time.

But if this literature implies that Mexican banks would be underloaning for years so they could overcharge, a parallel literature on financial liberalization in developing countries points toward overloaning. Under this paradigm, the problem would not be inadequate expansion of credit but too much expansion. The excessiveness would become recognizable ex post in a wave of loan defaults followed by other typical artifacts of a banking crisis.[4]

In this paradigm of financial liberalization, the large spreads between cost of funds and interest rates on loans need not suggest uncompetitive behavior. Instead, when a repressed financial system is liberalized, the banks are unable to supply intermediation services efficiently because they lack expertise, qualified human resources, and adequate technology. The result is high intermediation costs, represented by a large spread between cost of funds and interest rates charged (de la Cuadra and Valdés 1992). Newly liberalized banks' portfolios become riskier because the banks cannot evaluate the riskiness of loans and higher real interest rates under the new regime. Not only may lending expertise be scarce in general, but banks may lack experience with the new types of markets their increased funds permit them to enter.[5]

Consistent with this latter paradigm, the econometric results in Gruben and McComb (1996) suggest that what Shaffer (1993) has called a "supercompetitive" market materialized following the Mexican privatizations, as bank owners stretched their capital and deposits in efforts to swell loan portfolios in a manner consistent with short-run efforts to expand market share. That is, in the short run banks actually lent so much that they passed the point where marginal cost equaled marginal revenue, to a point where marginal cost exceeded marginal revenue. Of course, this is a relation that banks could never sustain in the long run.[6] Indeed, in the wake of privatization, there was much evidence to suggest banks began to expand consumer credit despite limited information on the creditworthiness of the borrowers. Well-organized credit reporting systems, so common in the United States, operated on only a very limited scale in Mexico.[7]

This behavior may be seen as just one part of an overall episode of lender and investor euphoria during the period that has been well characterized econometrically in an endogenous bubbles model of investor behavior by Ostos Jaye (1996). Here, euphoria is defined in the sense that Minsky (1982) uses it: banks allow their liquidity levels to be reduced and accept obligations that in other circumstances they would have rejected.

Gonzalez-Hermosillo, Pazarbaşioğlu, and Billings (1996) draw similar conclusions from an econometric model of banking system contagion effects, as these effects were expressed in Mexico's financial crisis. Their model suggests that contagion effects work through two channels: (1) through information asymmetries affecting depositor behavior and (2) as a result of herd behavior in bank risk-taking.

Lopez de Silanes and Zamarripa (1995) offer econometric results that suggest bank deregulation increased financial activity levels because of freer operating rules, while privatization led to a restructuring of operations, with a large increase in the loan portfolio growth rate and—importantly—a reduction in the securities portfolio growth rate. They also argue that the slow opening of the banking system to domestic de novo operations and foreign entry permitted greater than competitive profits for at least some institutions in the wake of privatization.

Regulatory problems

The rush of loan expansion, incomplete consumer credit assessment, and stresses resulting in the overvaluation of the currency converged to make loan defaults more common. Commercial banks' ratio of past-due to total loans and discounts rose from 5.5 in December 1992 to 8.3 in September 1994.[8] At the time, 8.3 seemed very high.

The euphoria that prompted increasing amounts of capital to flow into the system created problems for both financial regulators and the banks themselves. The problem during a strong economic upturn, as Hausmann and Gavin (1995) characterize it, is that the abundance of liquidity masks risky borrowers who would be recognized for what they are in less florid times.

Problems in the banks that became visible in the wake of privatization motivated speculative activity that weakened the banks further. Although universal banking systems like Mexico's present special regulatory problems involving what might be considered self-lending, Mexican accounting standards did not require consolidated reporting until 1995, making it difficult to establish limits on lending within financial groups. Moreover, increasingly sophisticated trading in derivatives allowed highly leveraged and risky currency plays to be presented quite legally to regulators as conservative investments in which dollar-denominated assets were matched by dollar-denominated liabilities (Garber 1996).

A related but more general regulatory problem may be inferred—as Gunther, Moore, and Short (1996) argue—from the preprivatization increase in past-due loans (from less than 1 percent at year-end 1988 to more than 3 percent at year-end 1991) while the capital-to-asset ratio declined (from 7 to 5.4 percent). They note that, considering Mexican banks typically rolled over past-due interest into the principal at maturity and recorded the capitalized interest as income, the deterioration in these measures, together with the simultaneous decline in return on assets, suggests marked financial difficulties. These elements of forbearance before privatization may have predisposed bank purchasers to expect such forbearance after privatization, which is what occurred.

Moreover, Mexican regulations do not impose upon shareholders the consequences of their banks' behavior as fully as do those of the United States. In at least one case, shareholders of a failed Mexican bank were not only permitted to retain equity interest after the bank's acquisition by another institution, but the Mexican government provided guarantees that protected the purchaser from losses on existing loans. Thus, Mexico not only preserved depositors' assets but, to some degree, the assets of the bank's stockholders.

The exchange rate crisis

During the Salinas administration, which commenced in December 1988, the rationalization of Mexico's fiscal, monetary, financial, investment, and trade policies—together with relatively high real interest rates in Mexico and low rates in the United States—precipitated large inflows of foreign capital. Mexico could use the resulting accumulations of foreign currency reserves to defend the peso. Capital inflows covered—and to a certain extent caused—the increasingly negative balance on current account.

By the first quarter of 1994, foreign currency reserves were approaching $30 billion, after having fallen below $5 billion in March 1990. Investor optimism about Mexico's policies was so high that, when rebels occupied San Cristobal de las Casas in January, the markets shook off the shock and capital poured in.

Mexico's presidential election was to take place in August, however. When Institutional Revolutionary Party candidate Luis Donaldo Colossio was assassinated in March, the killing triggered massive capital outflows. Foreign currency reserves fell from $29.3 billion in February to $16.5 billion in June.

Thereafter, the markets seemed to settle down. From June until mid-November, reserves fluctuated occasionally but not by very much. In October, however, an assassin had killed Institutional Revolutionary Party official Carlos Francisco Ruiz Massieu. His brother Mario, an official in the attorney general's office, was appointed to investigate the case. In mid-November, he resigned, complaining that his efforts were being obstructed. Reserves began to fall hard—from $17.667 billion at the end of October to $12.889 billion by the end of November. On December 20, Finance Secretary Jaime Serra Puche announced that the peso would devalue from 3.47 pesos per dollar to 3.99. This was not really a change in exchange rate regime, government officials explained; it was just an adjustment. The crawling-peg regime would remain in place, they said.

But would it? Investors knew that nearly $17 billion in dollar-indexed Mexican bonds were scheduled to mature in the first six months of 1995. Foreign currency reserves had not been that high for more than a month, and who knew how many bondholders would want to roll over

their bonds? Market participants precipitated a run on the peso, and two days after announcing the crawling-peg regime would remain in place, the government announced, late on December 22, that the peso would float. The peso–dollar exchange rate quickly headed toward 5 to 1. Reserves fell from $12.889 billion at the end of November to $6.278 billion by the end of December and to $4.440 billion by the end of January 1995.

The financial industry after the devaluation

The devaluation triggered capital outflows and high inflation. Interest rates rose so high that they not only put borrowers at risk but—because major interest rate increases push up loan default rates—imperiled lenders as well.

To squeeze inflation out of the system, the central bank began to restrict domestic credit to the commercial banking system and slow growth in the monetary aggregates. After some initially ginger efforts, the Bank of Mexico imposed highly restrictive credit and monetary policies in February and early March. Mortgage rates that had been 22 percent in November rose to 74 percent in early March. Also in March, the interbank loan rate briefly rose to 114 percent.

Under these conditions, even an inexperienced banker could foresee a new wave of past-due loans. Some analysts claimed that problem loans had doubled between December 1994 and March 1995.[9] Some banks reportedly suspended all mortgage, auto, and consumer loans until further notice and canceled loans to farmers for replacement parts and seeds for spring planting.[10]

As loan problems mounted, the government took steps not only to rescue the banks but to facilitate their purchase. NAFTA had decreed that, during the six-year transition beginning January 1, 1994, a U.S. or Canadian financial institution could acquire an existing Mexican bank only if it did not account for more than 1.5 percent of total Mexican bank capital. This rule meant that, at the time of NAFTA's ratification, only two Mexican banks were eligible for direct acquisition.[11]

Beginning in February 1995, a new Mexican law permitted foreign banking organizations to purchase Mexican banks that accounted for up to 6 percent of total Mexican bank capital (*capital neto*), legalizing purchase of all but Mexico's three largest institutions. That this step was part of a bank rescue package is evidenced by the 6 percent rule's application only to bank acquisitions. A foreign-owned startup bank would still have to follow the old 1.5 percent rule. That is, while it remained unacceptable to start a bank large enough to account for 6 percent of Mexican bank capital, it became acceptable to purchase and rescue a problem bank that big.

NAFTA had also imposed limits on total bank capital that all foreign-controlled banks could hold. Under NAFTA rules, the limit in 1995 would have been 9 percent. The new Mexican banking law raised this limit to 25 percent.

To address the mounting undercapitalization problems of a growing number of banks, the government designed a special recapitalization program known as PROCAPTE. Under PROCAPTE, troubled banks could raise capital by creating and selling subordinated convertible debentures (bonds) to the nation's deposit insurance authority, FOBAPROA. The debentures would mature in five years. The government set criteria for converting the debentures to equity if the bank turned out to be poorly managed or if insolvency was judged likely. Although this condition would make FOBAPROA (which is administered by Mexico's central bank) a commercial bank shareholder, the government has committed itself to sell such instruments as soon as they become shares.

In another effort to refinance the banks, Mexico introduced a round-robin program in which (1) banks repackage and restructure certain types of past-due private debt into bondlike instruments; (2) the government purchases this repackaged debt, issuing special bonds to raise the money for the purchases; and (3) the banks purchase these special government bonds. An important characteristic of the restructured debt is that it is denominated in so-called Unidades de Inversion (UDIs), whose nominal value is indexed to the inflation rate so as to preserve real value.

Although the program, in a sense, simply trades one type of bond for another, it spreads the impact of current losses over time. The plan permits problem banks to restructure (often short-term) past-due loans adjudged likely to pay out ultimately. Under the restructuring program, commercial loan maturities are extended to a range of five to twelve years. Mortgage loans are also subject to restructuring.

Conclusion

The Mexican financial market has changed significantly since the bank nationalization of 1982. First, the banking system has been privatized. Second, the banks have returned to universal banking and have turned away from the narrower version of banking the government man-

dated during the early and middle 1980s. Third, after consolidating under nationalization, the number of banks has increased substantially since privatization. Some signs that suggest increased competitiveness have surfaced. Fourth, during this period the government has weaned itself away from the banks as a dominant form of funding and created a modern securities market.

Even so, 1994 saw a crisis, just as 1982 had. Bad debts had become a serious problem in the two years before the December 1994 devaluation, and the problem grew substantially worse thereafter. The banking problems appear to be the outgrowth of aggressive lending activity that was consistent with a struggle for market share. Banking services were produced up to a level where marginal cost exceeded marginal revenue. Such seemingly shortsighted behavior could have had positive long-run consequences for market share under a happier ultimate scenario than actually occurred.

Moreover, the supervisory and regulatory framework was inadequate to keep up with banks' acquisition of increasingly risky loan portfolios or to monitor highly leveraged trades in the financial derivatives markets.

In addition, inasmuch as past-due interest was rolled over into the principal at maturity and capitalized interest was recorded as income, regulatory forbearance of problem loans and risky behavior was built into the system before privatization and remained afterward. Such forbearance is often described as imposing risk on the public without corresponding reward (Kane 1989, 1986; Akerlof and Romer 1993).

Although international markets initially reacted in 1994 and 1995 as they had in 1982, clear policy differences emerged. The government took steps to resuscitate the banks without nationalizing them. The Mexican government devised plans to bail out the banks through the rescheduling and securitization of their loan portfolios and also attempted to facilitate the purchase of existing banks.

In addition, the structure of Mexico's nonfinancial private sector was different enough in 1995 to offer a prognosis for the financial market different from that of 1982. As with other Latin American countries, the 1980s were a "lost decade" for Mexico, whose exports were dominated by raw materials sales and whose domestic production was state-dominated, heavily regulated, and inefficient. Since then, Mexico's newly rationalized manufacturing sector has greatly increased its share of the nation's exports.

While the devaluation has aggravated Mexico's financial problems, it has had a more positive effect on the country's manufacturing sector than the 1980s devaluations had on the oil industry. The earlier devaluations did not affect Mexico's ability to profit from oil sales then. In real-dollar terms, oil prices have not reached their levels of the middle to late 1970s and very early 1980s. But the 1994 devaluation appears to have raised the profitability of a large number of Mexico's manufacturing industries. Indeed, devaluation allows manufacturers to raise their peso prices enough to beat the cost–price squeeze discussed above and yet remain competitive on world markets in dollar prices. Mexico's economic restructuring over the past decade has made its nonfinancial sector more resilient in the face of economic shocks over the long run and, accordingly, has made its financial sector more resilient.

Nevertheless, financial operating ratios, spreads between cost of funds and loan rates, and the other characteristics of Mexico's banking system suggest that its financial sector has some distance to go before it meets developed-country standards.

Notes

[1] For more comprehensive discussions of this issue, see Mansell Carstens (1995a and 1993a).

[2] See Mansell Carstens (1993a) for fuller discussion of this issue.

[3] When the Mexican commercial banking system was nationalized in 1982, there were sixty Mexican banks, of which fifty-eight were nationalized. To capture perceived economies of scale, the government reorganized the industry by merging its fifty-eight banks into eighteen. Although the industry had been consolidating during the period leading up to 1982, these mergers significantly increased concentration. Accordingly, the system emerged from its state ownership under a considerably different structure than prevailed in 1982.

[4] Gorton (1992) characterizes the common trajectory after financial liberalization and the appearance of new or newly private banks as involving rapid increases in bank assets, while de Juan (1995) notes that when new owners take control of a bank, increases in lending relative to the value of equity capital or deposit base are common. Whether or not these liberalizations and related rapid loan expansions are followed by large increases in loan defaults, as they are in Gorton's and de Juan's characterizations, a common adjunct to liberalization is often said to be markedly increased competition in the banking system (International Monetary Fund 1993).

[5] It should be noted that while bank privatization was an

important financial market reform, it was by no means the only one. Beginning in November 1988 and largely finishing in 1990, Mexico removed controls on interest rates on bank liabilities and assets, eliminated sector-by-sector quotas and all other obligatory or targeted lending, and phased out reserve requirements and liquidity coefficients. Moreover, as Mansell Carstens (1995a) notes, in 1988 20 percent of Mexican government financing came from the banking system, but by 1993 all such financing occurred in the money market. To offer another perspective, in 1988 only 25 percent of bank lending was unrestricted, with the rest required as credits to the federal government, as deposits in the central bank, or as other obligatory credits. By 1990, the year before the privatizations began, 70 percent of bank lending was unrestricted and by 1991, 100 percent was. After the Mexican government sold off the existing commercial banks in 1991–92, the establishment of new private-sector banks began in 1993, while the introduction of NAFTA in 1994 permitted foreigners to establish new banks or purchase smaller existing institutions, and the financial crisis that began in 1994 motivated in 1995 a liberalization of rules on foreign acquisition of existing Mexican banks. See, for example, Gruben and Welch (1996).

[6] Despite the obvious possibilities for bad outcomes from such market share struggles, because of the tendency toward brand loyalty in consumer finance, there is much to recommend them if an institution can survive their early stages. For example, a survey of U.S. credit card users found that most still use the first card they got (*Wall Street Journal* 1996).

[7] According to officials of the central bank, after the privatizations it was not unusual for those taking a lunchtime walk in nearby Alameda Park to be accosted by hawkers trying to enroll passersby for credit cards.

[8] Although the changes in the past-due loan ratio may be instructive, the ratios themselves are not easily compared with U.S. past-due loan ratios. Mexican banks have traditionally reported as past due only the actual loan payment that was past due thirty days or more and not the remaining balance on the loan. In the United States, if a loan payment is past due ninety days or more, the entire loan balance is reported as past due.

[9] See Crawford (1995), 4.

[10] See *El Financiero: International Edition* (1995, 26).

[11] For further details, see Edmonds (1995) and Gruben, Welch, and Gunther (1994).

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