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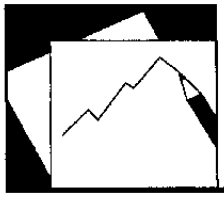

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"Big Bang" Versus Gradualism in Economic Reforms: An Intertemporal Analysis with an Application to China

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"Big Bang" Versus Gradualism in Economic Reforms: An Intertemporal Analysis with an Application to China

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Abstract

This paper reviews briefly the controversy in the literature concerning the speed of adjustment and sequencing of reforms, and presents a model parameterized with Chinese data. The model is used to generate different policy simulations to illustrate some of the key issues in the debate on the speed and sequencing of reforms, and not to provide a basis for policy recommendations for China. The simulations highlight the importance of the criteria being used for determining speed and sequencing. The paper also underscores the limitations involved in attempting to derive conclusions from the model, given the complexity of the issues.

JEL Classification Numbers: D58,P21

Keywords: Transition, sequencing of reforms, speed of adjustment

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I. INTRODUCTION[1]

This paper analyzes the implications of two alternative paths of economic reform[2] for an economy with a large public sector that is being transformed to become more market oriented. In the first, the country moves gradually by selectively introducing reforms and spacing them over time. In the second, the country pursues a "big-bang" approach, by which the government immediately and simultaneously introduces all the reforms.

In the economic literature, no consensus has emerged on whether the big-bang or the gradual approach is the superior one. Further, the order in which reforms are undertaken remains in debate. In this paper, we will first briefly review some of the issues involved in considering the appropriate pace and sequencing of reforms. Second, we will examine the economic setting in China, the rationale for the model we use, and the policy variables at the center of the simulations. Third, we will present a dynamic general equilibrium model to analyze the effects of the relative speed and sequencing of reforms. Fourth, the model will be solved numerically, permitting us to carry out simulations for different policies.

The focus of the simulations is on the speed of introducing a limited number of policy and reform variables: privatization, devaluation, and tariff reform. Beyond these variables, the simulations do not address the general issue of just how general reform should be. Clearly, there are many possible policy and reform variables that are not considered in this study. Nor is the issue of sequencing—that is, the order in which reforms are introduced—addressed fully in the simulations. However, some sequencing conclusions can be drawn from examining different combinations of the three variables. Given the limitations of the model and the simulations, no policy conclusions with regard to China should be drawn from the results. In addition, the policy issues that are examined in this paper are not necessarily the most critical issues currently facing China.

II. BACKGROUND[3]

The literature on the speed and sequencing of economic reforms is extensive but inconclusive. The theoretical work on the subject has not established the superiority of one

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[1] We would like to thank Stanley Black, Ralph Chami, Norbert Funke, Magda Kandil, Mohsin S. Khan, Mounir Rached, Markus Rodlauer, Sunil Sharma, and Harm Zebregs for helpful comments and suggestions.

[2] Defined to include macroeconomic adjustment policies as well as structural reforms.

[3] This section draws on Edwards (1982), Funke (1993), Nsouli, Cornelius, and Georgiou (1992), Nsouli (1996), and Nsouli and Rached (forthcoming).

course of reform over another. The same applies to the empirical literature. There are cases where fast and gradual reformers have succeeded and where they have failed. In general, the discussion in the literature has been fragmented in that it has taken sectoral rather than a comprehensive look at the reform packages. Much of the early literature dealt with trade liberalization, with the focus shifting over time to deal with current and capital account liberalization and the interaction between stabilization policies and structural reforms. Although it is sometimes difficult to categorize work in this area, it is nonetheless possible to separate papers that argue in favor of rapid reform from those that argue in favor of a gradual approach.

The case for rapid reform is made on the basis of four main arguments. First, rapid reform increases the incentives to relocate resources, resulting in a more rapid relocation of resources and, therefore, lower adjustment costs than if the relocation was prolonged (Mussa, 1984). Second, a fast reform process affords better coordination in the implementation of the reforms (Murphy, Shleifer, and Vishny, 1992). Third, full-scale reforms implemented rapidly help establish credibility in the reform process (Heimenz and others, 1992, and Funke, 1993), leading the private sector to relocate resources rapidly and increase investment. Fourth, a rapid introduction of reforms can overcome the political resistance to prolonged reforms, leading to an effective implementation of the reform package (Lal, 1987, and Krueger, 1992).

There are equally valid arguments for pursuing a gradual reform path. First, in the real world resources cannot be moved instantaneously and without cost to different sectors of the economy, and different markets adjust to policy changes and price signals at different speeds. Thus, gradualism can minimize adjustment costs (Little, Scitovsky, and Scott, 1970). Second, to the extent that the use of certain instruments can be incompatible with certain targets, a phased approach to reforms is needed. McKinnon (1973), in particular, argues that the use of exchange rate policy conflicts with the simultaneous introduction of trade and capital account liberalization, as the former requires a depreciation and the latter an appreciation. Third, credibility can be enhanced by gradual and successful reforms, while broad and drastic reforms carry the danger of overall failure if there is a problem in one area (Rodrik, 1989). Fourth, to the extent that the costs of adjustment can be spread out, there is likely to be more political support for a phased approach (Gavin, 1996, and Agenor and Montiel, 1999). Finally, it is just not practical to try to introduce many reforms at once and, even then, it takes time to implement them (Gelb and Fischer, 1991).

Given the opposing arguments, it appears difficult to reconcile the views of the proponents of the big bang with those of the gradualist approach. However, this can be done conceptually by defining the problem as that of finding the *optimal adjustment trajectory that will maximize the intertemporal social welfare function of the country, taking into account the social discount rate, subject to various financial and structural constraints* (Nsouli, 1996).

Based on this maximization problem, three generalizations would seem plausible if the adjustment costs are initially higher than the benefits:

- the higher the social discount rate, other things being equal, the lower the optimal speed of adjustment—since there will be a tendency to defer net costs;

- the greater the financial constraints, other things being equal, the faster the speed of adjustment required—whether orderly or disorderly; and
- the greater the structural constraints in infrastructure, institutional capacity, administrative capacity, and so forth, other things being equal, the slower the speed of adjustment.

From these, it follows that:

- if a reform program is designed to move at a faster rate than provided by the social discount rate, other things being equal, social tensions will rise, leading to a disruption of the adjustment process;
- if a program is designed to move at a slower rate than implied by the financial constraints, other things being equal, the adjustment process will break down because of lack of resources;
- if a program is designed to move at a faster pace than the structural constraints allow, the process will again breakdown because of the problems encountered during implementation; and
- if a program is designed to move at a slower speed than given by the optimization solution, it follows tautologically that welfare losses will result.

The above conceptual discussion of the pace at which convertibility can be achieved provides only a broad framework; it is of little practical use in determining the speed at which macroeconomic adjustment and structural reforms should take place or the sequence in which reforms should be phased. Nonetheless, there are a number of essential interrelated practical considerations in determining the time frame and the phasing of reforms in an adjustment program attempting to transform an economy.

Two practical considerations are critical when considering the time frame:

Required financing. The external financing required for adjustment should be compatible with a return to a viable balance of payments position; that is, the resulting debt-service ratio should not undermine the external sector position. If this condition is not satisfied, the country will in due course run against the external sector constraint, leading to a breakdown of the reform process at the pace at which it is being implemented.

Available financing. The overall speed of adjustment cannot be slower than that given by the availability of external financing, subject to the consideration above. If the process is slower, the financing constraint will disrupt the reform process.

The following considerations are important for determining sequencing:

Macroeconomic policies. Given that the alignment of aggregate demand with available resources is critical for financial stability, the adoption of sound fiscal, credit, and exchange rate policies needs to be given priority.

Compatibility. Structural reforms need to be introduced in a manner compatible with the reestablishment of macroeconomic stability. For example, although the rationalization (and reduction) of tariff structures are essential to reduce distortions, they can also have immediate adverse effects on revenue and the budget deficit; although tax reforms are essential for reducing financial imbalances, they can take time to be introduced; and although increased emphasis on credit to the private sector is essential to finance investment for improving the incentive structure, increased credit could also be incompatible with an acceptable rate of monetary expansion.

Complementarity. The complementarity of policies should determine the timing of actions. Consider a country with an overvalued exchange rate and price controls. An adjustment in the exchange rate will only have the desired absorption and expenditure-switching effects if domestic prices are concurrently deregulated (or adjusted) to reflect the exchange rate change. Similarly, the positive effects of liberalizing trade restrictions are reaped only if domestic prices are deregulated. However, an ensuing sharp rise in prices can be limited only if restrained fiscal and monetary policies are put in place.

Lead time. Structural reforms should be phased in, taking into account the time needed for the requisite preparatory work, the implementation, and, where applicable, the gestation period. For example, if tax reforms are needed to improve the fiscal position in order to reduce excess demand pressures, the phasing will depend on the time required to prepare the studies, recruit or train the requisite personnel, prepare and adopt the legislation, put in place a functioning institutional structure, and generate the requisite revenue.

Distribution effects. The phasing of reforms to achieve convertibility should take into account income distribution effects. Reforms that in the short run adversely and simultaneously affect large segments of the population or the most vocal and politically influential segments may lead to social tensions that would derail the reforms and lead to higher adjustment costs.

As will be evident from the discussion of the model below, many of the issues discussed above are not incorporated into the model, but they are important to consider because of their practical importance and because they highlight the limitations of the model.

III. THE REFORM SETTING AND MODEL INTUITION

Because the model we use is applied to China, in this section, we provide some background information on the Chinese reform process. China has carried out a variety of discrete changes to its economic system. Given the limited scope of this paper, we will analyze only a few of these policy changes. We note, however, that there is a general theme that connects most of these shifts—namely that there has been a general move toward the decentralization of economic decision making and a reduction in government-induced distortions in the economy. These policy shifts have a long history in China.

Between 1949 and 1996, the Chinese economy experienced frequent cycles where economic policy shifted between decentralization and recentralization programs. In the early 1950s, the Soviet model of central planning shaped the relationships between the state council and local governments. The central authority exercised direct administrative control over local governments through three central planning mechanisms: the physical planning of production, centralized allocation of materials, and budgetary control of revenues and expenditures. The central authorities directly controlled major enterprises, distributed funds, and supervised fixed investment through a centralized budgetary allocation. At the same time, production was carried out entirely through state-owned enterprises and collectives, the exchange rate was fixed, and the economy was essentially closed through a system of quantitative restrictions and prohibitive tariffs.[4]

As the economy grew in size and complexity, central decisions were inevitably made with inadequate information. Concentration of power at the center reduced the initiative of local governments and harmed production, leading in 1957 to the move to decentralization. A wave of recentralization, however, began in the early 1960s, when almost all large and medium-sized enterprises were returned to the central authority. A new decentralization movement started in 1964 and continued throughout the Cultural Revolution. In the 1970s, most central authority over enterprises was transferred to local governments, which were allowed to retain enterprise depreciation funds.

Before 1979, China's budgetary policy essentially consisted of generalized tax collection and profit remittances controlled by the central government and then redistributed as needed to the provinces. This system of "eating from one pot" was changed in the 1980 intergovernmental reform, under which different jurisdictions were assigned different expenditure responsibilities and were made responsible for collecting necessary revenues and managing their own budgets. Regions that raised more revenues than were necessary were permitted to retain the excess, giving them an incentive to increase revenue collection. This ability to retain revenues was especially attractive to newly privatized state-owned enterprises, which now were able to take advantage of locally provided public infrastructure. At the same time, decentralization was supported by the gradual opening of foreign markets and sequenced devaluation of the exchange rate. All of these changes tended to permit newly privatized firms to operate in a more market-oriented economy than had existed at the beginning of the decentralization process.[5]

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[4] It is difficult to determine whether the Chinese real exchange rate is over or undervalued. There has been a significant increase in foreign exchange reserves. At the same time, however, existing capital controls complicate an evaluation of the appropriate exchange rate level.

[5] It is beyond the scope of this paper to fully analyze Chinese decentralization. For a review of Chinese fiscal decentralization, see Bell, Khor and Kochhar (1993), Lardy (1998), Tseng and others (1994), Hofman (1993), and World Bank (1994, 1996). A broad historical and analytical survey of Chinese fiscal and macroeconomic policies is given in J. Ma (1997).

Economic decentralization in the post reform period has explicitly aimed at introducing a free market economy by gradually removing price controls. Decentralized resource allocation allowed an increase in investment in efficient nonstate firms, leading to a rise in aggregate economic growth. But productivity in the inefficient state sector lagged behind that in the nonstate sector.[6] To sustain public welfare, the central government found it necessary to support the ailing state-owned enterprises. Further, by weakening the central government's credit control, fiscal federalism in effect created a situation in which the central government had to finance transfers to state-owned enterprises by money creation.[7] The relative inefficiency of state-owned firms implies that they tend to be hurt by tariff relaxation more than do the privatized, or nonstate, enterprises. At the same time, they tend to benefit less from devaluations.

Against this background, we will consider three types of policy reforms in our simulation analysis: state enterprise reform, exchange rate policy, and external sector liberalization. Although there are many other reforms that can be examined, these three should give a sense of the lessons to be drawn from our model. More specifically in terms of the model we use, the following reforms are analyzed:

1. *Privatization of capital*: Initially, the government owns capital. Capital is sector specific. We assume that the private sector is more efficient than the public sector. We allow privatization to be introduced either gradually or immediately.

2. *Devaluation*: We start with an overvalued exchange rate. We then explore two devaluation paths. At one extreme, there is an up-front devaluation; at the other, the devaluation is effected gradually through several discrete steps.

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[6] See Groves and others (1994), Dollar (1990) and Jefferson and others (1999) for further discussion of changes in Chinese productivity. The general relationship between fiscal policy and growth is examined in Easterly and Rebelo (1993).

[7] Such a mechanism is described in Brandt and Zhu (2000), who say, "Employment and investment growth in China's inefficient state sector have been supported by the government with transfers in the form of cheap credits from the state-owned banks and money creation. While this increases output growth, it also forces the government to rely more heavily on money creation to finance the transfers to the state sector, which causes inflation to increase as well." World Bank (1994) maintains that China's inflation can be explained by the effect of decentralization on both the public sector deficit and control over monetary expansion. Having no independent central bank, China controls monetary expansion by setting credit ceilings and controlling interest rates. The credit plan designed by the People's Bank of China, the State Planning Commission, and the Ministry of Finance has been weakened by state-owned enterprises and local governments, which do not respect credit limits. Pressure to support distressed state enterprises has resulted in budget subsidies and the granting of soft loans. Because their own on-hand deposits are typically insufficient to cover credits, banks often seek extra funds from the People's Bank of China, leading to money creation and inflation.

3. *Tariff reduction*: We take the tariff structure in China in 1994, and examine the effects of both gradual and immediate uniform tariff reductions.[8]

We should view our exercises as essentially casting light on the issues of speed and sequencing of reforms, but not as being necessarily applicable to China. The reforms that China implemented are quite different from those we simulate. In particular, the privatization that it has carried out so far has been incomplete and most capital still remains in the public sector. Nor did China make an active use of exchange rate policy in the past. In addition, it did not make a significant move towards trade reform. Hence our exercises need to be viewed more as an examination of the effects of hypothetical policies.

Our analysis is carried out in the context of an intertemporal general equilibrium system. In general, the model provides a framework within which all agents optimize over time. There are heterogeneous consumers, public and private firms, as well as public and private investment, and a public sector that collects taxes and spends. We permit various degrees of openness in the foreign sector and have a fixed exchange rate that can be varied at discrete intervals. Although the model cannot be solved analytically, we will implement a numerical version of the model with estimated Chinese parameters, which will be solved to generate outcomes resulting from aforementioned three reforms.

IV. MODEL STRUCTURE

This section develops the analytical structure of a model that incorporates a number of features of the conceptual framework discussed above.[9] Much of this structure is designed to permit a numerical implementation. The model has n discrete time periods. All agents optimize in each period over a two-period time horizon. That is, in period t they optimize given prices for periods t and $t+1$ and expectations for prices for the future after $t+1$. When period $t+2$ arrives, agents reoptimize for period $t+2$ and $t+3$, based on new information about period $t+2$. For example, because of a technology shock, certain banks may have become insolvent, or the structure of demand may have changed. Thus the savings decision made in period $t+1$ may not give an optimal allocation when period $t+2$ arrives.

We thus have a system in which expectations are consistent for 2 periods and then may be inconsistent thereafter. Updating takes place and expectations are again consistent for 2 periods and inconsistent thereafter. We adapt this framework for essentially technical reasons. We wish to avoid having a perfect foresight model since it would not be possible to generate

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[8] We do not tackle the issue of quantitative restrictions.

[9] The basic structure of this model, in a non-transition economy, is developed in Blejer, Feldman, and Feltenstein (2000) and Ball and Feltenstein (2000).

unexpected events in such a model. The alternative would, of course, be to develop a stochastic model. The additional complexity of such a model is, however, beyond the scope of the current computational framework; we thus have chosen to avoid it.

The model structure is related to a number of earlier papers, possibly starting with Strotz (1956). Here preferences are inconsistent over time, primarily because the future does not turn out as anticipated. Thus it may be optimal for agents to commit themselves for a few periods into the future. They may be better off, however, if they reoptimize at some later date, based on their own changed preferences or changes in economic variables. This is quite different from the notion of time inconsistency of Kydland and Prescott (1977), where rational behavior by economic agents itself leads to inconsistencies in what would otherwise be an optimal government plan.

The model will have certain features that distinguish it from a standard representation of a market economy. In particular, it has production by both the state and private sectors. In general, we will suppose that the private sector profit maximizes, while the public sector has other goals, such as output or employment targets. A key feature of the transition period will be the privatization of public production, through the transfer of capital to private firms. We will permit gradual, as well as immediate, changes in privatization and certain other variables, such as trade restrictions or the exchange rate.

A. Production

Private sector

There are eight factors of production and three types of financial assets:

1-5. Capital types
6. Urban labor
7. Domestic currency
8. Bank deposits
9. Foreign currency
10. Rural labor
11. Land

The five types of capital correspond to five aggregate nonagricultural productive sectors. We could have any number of capital types without affecting the structure of the model, so our choice of five is essentially arbitrary.[10] The initial ownership of each capital type is divided between the public and private sector. Each of these factors and financial assets is replicated in each period and, accordingly, has a price in each period. Period 1 domestic currency is the numeraire.

[10]We wish to avoid using a single, perfectly mobile, capital type since it would generate overly rapid sectoral adjustments.

An input-output matrix, A_t, is used to determine intermediate and final production in the private sector in period *t*. Corresponding to each sector in the input-output matrix, sector-specific value added is produced using capital and urban labor for the nonagricultural sectors, and land and rural labor in agriculture.[11] Assuming that more than five sectors exist in the economy, the different factors would be allocated across the economy so that agriculture uses land and rural labor, and all other sectors use one of the five capital types plus urban labor. Accordingly, capital is perfectly mobile across a given subsector, but is immobile across other subsectors. Labor, on the other hand, may migrate from the rural to the urban sector, subject to an estimated elasticity that could, in fact, be equal to 0, representing completely immobile labor.

The specific formulation of the private sector firm's problem is as follows. Let y_{Ki}^j, y_{Li}^j be the inputs of capital and urban labor to the *j*th nonagricultural sector in period *i*. Let Y_{Gi} be the outstanding stock of government infrastructure in period *i*. The production of value added in sector *j* in period *i* is then given by:

$$va_{ji} = va_{ji}\left(y_{Ki}^j, y_{Li}^j, Y_{Gi}\right) \qquad (1)$$

We suppose that public infrastructure may act as a productivity increment to private production.

Sector *j* pays income taxes on inputs of capital and labor, given by t_{Kij}, t_{Lij}, respectively, in period *i*. Agriculture is taxed on its use of labor.[12] Hence the effective price for labor and capital paid by sector *j* is:

$$\tilde{P}_{Lij} = \left(1 + t_{Lij}\right)P_{Li},\ \tilde{P}_{Kij} = \left(1 + t_{Kij}\right)P_{Kij} \qquad (2)$$

Thus if $\tilde{P}_{Kij}, \tilde{P}_{Lij}$ are the prices of capital and labor in period *i*, then the prices charged by enterprises, P_i, are given by

[11]The use of neoclassical value added functions "sitting above" an input-output matrix is common. The reader may wish to see Shoven and Whalley (1984) for articles that use this approach.

[12]The interpretation of these taxes is thus as a profit tax and a personal income tax that is withheld at the source.

$$(P_i) = va(P, Y_{Gi})(1+t)(I - A)^{-1}$$

where $va(P, Y_{Gi})$ is the vector of cost-minimizing value-added per unit of output.

We suppose that each type of sectoral capital is produced through a sector-specific investment technology that uses inputs of capital and labor to produce new capital. Both the public and private sector invest and produce sectoral capital. Investment that is carried out by the private sector is entirely financed by domestic borrowing.[13]

The private investor may receive an investment tax credit as well as a depreciation allowance. He also pays a capital, or profit tax, on the returns to his investment. Let us define the following notation.

k_i = Investment tax credit in period i (percent).

d_i = Depreciation allowance in period i (percent).

t_{ki} = Profit (capital) tax rate (percent)

C_{Hi} = The cost of producing $_i$ the quantity H of capital.

r_i = The interest rate in period i.

p_{Ki} = The return to capital in period i.

P_{Mi} = The price of money in period i.

δ = The rate of depreciation of capital.

It is assumed that the interest rate is market determined, although it remains controlled in China. Suppose, then, that the rental price of capital in period 1, or whatever the current period might be, is P_1. If C_{H1} is the minimum cost to produce the quantity of capital, H_1, then the cost of borrowing must equal the present value of the return on new capital. Hence:

[13]For simplicity, the model assumes that all foreign borrowing is carried out by the government, so that, implicitly, the government is borrowing for the private investor but the debt incurred is publicly guaranteed. The Chinese Government, however, does not in practice borrow on behalf of the private sector in China.

$$C_{H1}(1-k_1-d_1)=\sum_{i=2}^{N}\left[\frac{(1-t_{Ki})P_{Ki}(1-\delta)^{i-2}H_1}{\prod_{j=1}^{i-1}(1+r_j)}\right] \qquad (3)$$

where r_j is the interest rate in period j, given by:

$$r_j = 1/P_{Bj}$$

and P_{Bj} is the price of a bond in period j. Accordingly, the investor takes out a loan from the banking system to cover his costs. This loan then becomes an asset of the banking system.

We make one further assumption about the behavior of the private sector firm. The firm, like all other agents in the model, optimizes with a two-period time horizon for which it knows all prices. After the second period it assumes that future interest rates and returns to capital will remain the same as in period 2.[14] Hence $P_{Ki}=P_{K2}, r_i=r_2; i>2$. If at some point the present value of investment, as given in equation (3), falls below the corresponding value of debt service, then the sector is unable to pay its debt obligations, which were incurred to finance this investment. Accordingly, the bank that holds these assets now holds corresponding bad debts. This situation might occur if, after the investment was incurred, the interest rate rose or the rate of return to capital fell because of some unanticipated event. We assume that a bankrupt firm cannot invest.

Public sector

We take a very simple view of public sector production. We will suppose that state-owned enterprises have the same production technology for intermediate and final goods as do those firms in the private sector. Hence there are no efficiency gains in current production if production is transferred from the public to the private sector. We make this assumption for essentially data-based reasons. It will not be possible, using Chinese data, to estimate separate production functions for public and private sector firms.

We do, however, assume that public sector investment is different than private sector investment. First, we will assume that public sector investment functions are different than those represented by the cost functions C_{H1} in equation (3). In particular, we will assume that the public sector investment function are constant returns to scale. Second, we will assume that the public sector firms do not invest in an optimal fashion, as in equation (3). Rather, the

[14]We could have other types of expectational mechanisms, such as one in which the firm uses the trends of past prices to predict those for the future after period 2.

government allocates an arbitrary amount of revenues to investment in each sector. Suppose then that the government decides to spend $GINV_i$ on public enterprise capital formation in period *i*. Let public enterprise firm *j* have a Cobb-Douglas investment function with coefficients $\gamma, 1-\gamma$.

We suppose that the government allocates $GINV_i$ to the different public enterprises according to an arbitrary set of policy weights η_{ij} in period *i*. Thus the government spends $\eta_{ij} GINV_i$ on sector *j*'s investment in period *i*. Accordingly, sector *j* uses $\frac{\gamma_j \eta_{ij} GINV_i}{P_{Kij}}$ units of capital as inputs to investment in period *i*, and $\frac{(1-\gamma_j)\eta_{ij} GINV_i}{P_{Kij}}$ units of labor. The capital thus produced is then available in period $i+1$.

Thus public investment in public enterprises is determined purely by policy considerations, rather than intertemporal profit maximization. In addition, this capital formation may be financed by taxes or by borrowing, unlike private investment, and it may be loss-making over time, even in the absence of shocks. That is, the public sector may over-invest for noneconomic reasons.

Privatization

We will implement a simple form of privatization of public enterprises. That is, when the government privatizes a state enterprise, it simply gives the capital of the state enterprise to the corresponding private firm. This privatization can be partial. That is, the government gives a portion of the publicly owned capital to the corresponding private firm and retains a fraction for itself. We thus avoid any issue of the marketing and pricing of public capital. As public capital is allocated to the private sector, there is a corresponding reduction in public capital expenditure on state-owned enterprises. This description is, of course, a simplification. In China, some of the proceeds from privatization are used to finance a partially funded pension system.

B. Banking

The banking sector in our model is quite simple and is meant to capture some of the key features and problems in China, as well as in other developing countries. We will suppose that there is one bank for each nonagricultural sector of the economy. There are five such sectors, hence five banks. Each bank lends primarily to the sector with which it is associated. However, the banks are not fully specialized in the sector to which they correspond. For simplicity, we will make the assumption that each bank holds 50 percent of the outstanding debt of its particular sector. It then holds 12.5 percent of the debt of each of the remaining four sectors. Hence, bank 3, for example, holds 50 percent of the debt of sector 3 and 12.5 percent of sectors 1, 2, 4, and 5. Similarly, it makes 50 percent of the loans to sector 3 and 12.5 percent of the loans to the other

four sectors.[15] We make this assumption of diversification of assets so that unequal privatization across sectors will have unequal impact on different banks.

We will suppose that banks follow a strategy of lending that looks at the risks associated with their borrowers. That is, as their borrowers become more insolvent, the banks ration credit to those borrowers.[16] We will choose a simple functional form that connects credit rationing to borrower insolvency. Suppose that C_{Hij} is the demand for borrowing by sector j in period i. Suppose also that bank k has Def_{ik} percent of its total assets in default in period i. Let $\delta_k \geq 0$ be a parameter specific to bank k, and let β_{jk} be the share of borrowing by sector j taken by bank k. Sector j then receives loans L_{ji} where:

$$L_{ji} = \sum_{k=1}^{5} \beta_{jk} (1 - \delta_k Def_{ik}) C_{Hij} \qquad (4)$$

Thus, if there are no bank assets in default, then no credit rationing takes place. If assets are in default, then the credit demanded by sector j for investment is reduced by each bank proportionally to the share of that bank's defaulted assets in total assets.[17] The parameter δ_k is bank specific and is some measure of the risk aversion of the particular bank. Higher values of δ_k indicate a more rapid contraction of credit in response to bad loans.[18] Another interpretation of this parameter is that higher values of δ_k reflect more proactive banks. Low values would represent relatively passive banks. Our numerical simulations will show that this admittedly ad hoc formulation of optimizing behavior by banks leads, in fact, to fewer failures of those banks.

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[15]Clearly these percentages are arbitrary and should serve only for illustrative purposes. We could have any initial pattern of distribution of bank assets across the different sectors.

[16]The rational for this approach is that banks are aware that depositors will withdraw their deposits if they believe bank assets are risky. In order to reduce these withdrawals, the banks in turn ration credit to risky borrowers. Our approach is a simple version of that presented in Calomiris and Wilson (1998). In fact, Chinese depositors, who have no alternative to the banking system, are unlikely to withdraw their deposits. In addition, banks continue to make loans to public enterprises in China. Furthermore, the capital adequacy ratios in the Chinese banking system are low.

[17]We are thus abstracting from any uncertainty across firms, as well as any notion of private information about those firms. The only information banks possess about firms is their stock of defaulted assets.

[18]Clearly δ_k is not derived from optimization, but is taken to be exogenous and does not vary over time.

Our formulation of bank behavior is meant to capture an element of profit maximizing conduct in a model without uncertainty.

We impose a solvency requirement on the banking system. Namely, if α percent of a bank's assets is in default, caused by a corresponding insolvency in its borrowers, then the bank is declared insolvent. At this point, a fraction of the bank's deposits is seized by the government.[19] In particular, depositors in the bank find part of their deposits frozen. We use a simple rule to determine the fraction of a bank's deposits that are seized. If Def_{ik} is the share of bank k's assets that are in default in period i, as before, then regulators seize $\omega_k Def_{ik}$ of the bank's deposits, where ω_k is a bank specific parameter. This seizure of deposits correspondingly reduces the bank's ability to lend.

Thus the bank's supply of loans, hence its assets, is determined by the demand for loans from the productive sectors of the economy, as well as the risk imputed to potential borrowers. Of course its supply of loans is also restricted by the bank's existing capital. The demand for loans is, in turn, determined by the investment equations described in the previous section. The banks' deposits, hence liabilities, are determined by the consumers' savings behavior.

C. Consumption

There are two types of consumers, representing rural and urban labor. We suppose that the two consumer classes have differing Cobb-Douglas demands. The consumers also differ in their initial allocations of factors and financial assets. The consumers maximize intertemporal utility functions, which have as arguments the levels of consumption and leisure in each of the two periods. We permit rural-urban migration, which depends upon the relative rural and urban wage rate. The consumers maximize these utility functions subject to intertemporal budget constraints. The consumer saves by holding money, domestic bank deposits, and foreign currency. He requires money for transaction purposes, but his demand for money is sensitive to changes in the inflation rate. In addition, the consumer's demand for bank deposits is sensitive to his perception of the solvency of the banking system. In particular, as banks increasingly incur bad loans, the consumer's interest elasticity of money declines, causing him to reduce his bank deposits.[20]

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[19]This figure of α percent is taken simply to correspond to standard bank regulations. That is, if the average ratio of capital to total assets in the banking system is approximately α percent, then an α percent loss of assets would be tantamount to a total liquidation of capital. In practice, a figure of 8 percent is generally used by regulators in the United States.

[20]This reflects the notion that the consumer worries about the safety of his own deposits as he sees the banks become progressively more insolvent.

Here, and in what follows, we will use x to denote a demand variable and y to denote a supply variable. To avoid unreadable subscripts, let us let 1 refer to period i and 2 refer to period i+1. The consumer's maximization problem is thus:

$$\max U(x),\ x=(x_1, x_{Lu1}, x_{Lr1}, x_2, x_{Lu2}, x_{Lr2}) \tag{5}$$

such that:

$$(1+t_i)P_i x_i + P_{Lui}x_{Lui} + P_{Lri}x_{Lri} + P_{Mi}x_{mi} + P_{Bi}x_{Bi} + e_i P_{Bfi}x_{BFi} = C_i \tag{5a}$$

$$P_{K1}K_0 + P_{A1}A_0 + P_{Lu1}L_{u1} + P_{Lr1}L_{r1} + P_{M1}M_0 + r_0 B_0 + P_{B1}B_0 + e_1 P_{BF1}B_{F0} + TR_1 = N_1$$

$$P_{K2}(1-\delta)K_0 + P_{A2}A_0 + P_{Lu2}L_{u2} + P_{Lr2}L_{r2} + P_{M2}x_{M1} + r_1 x_{B1} + P_{B2}x_{B1} + e_2 P_{BF2}x_{BF1} + TR_2 = N_2$$

$$C_i = N_i$$

$$\log P_{Bi}x_{Bi} - \log e_i P_{BFi}x_{BFi} = \alpha + \beta(\log r_i - \log \frac{e_{i+1}}{e_i} r_{Fi}) \tag{5b}$$

$$\log(L_{ui}/L_{ri}) = a_1 + a_2 \log \frac{P_{Lui} - P_{Lri}}{P_{Lui} + P_{Lri}} \tag{5c}$$

if $P_{Lui} \geq P_{Lri}$; otherwise $\log (L_{ui}/L_{ri}) = 0$

(if the representative household is rural, otherwise labor holdings are constant)

$$\log P_{Mi}x_{Mi} = a + b \log (1+t_i)P_i x_i - c \log \pi_i;\ c = c(DEF/ASSETT) \tag{5d}$$

$$P_{B2}x_{B2} = d_0 + d_1(1+t_2)P_2 x_2 + d_2\left[\frac{r_2 - \pi_2}{1+\pi_2}\right] \tag{5e}$$

where:

P_i = price vector of consumption goods in period i;

x_i = vector of consumption in period i;

C_i = value of aggregate consumption in period i (including purchases of financial assets);

N_i = aggregate income in period i (including potential income from the sale of real and financial assets);

t_i = vector of sales tax rates in period i;

P_{Lui} = price of urban labor in period i;

L_{ui} = allocation of total labor to urban labor in period i;

x_{Lui} = demand for urban leisure in period i;

P_{Lri} = price of rural labor in period i;

L_{ri} = allocation of total labor to rural labor in period i;

x_{Lri} = demand for rural leisure in period i;

a_2 = elasticity of rural/urban migration;

P_{Ki} = price of capital in period i;

K_0 = initial holding of capital;

P_{Ai} = price of land in period i;

A_0 = initial holding of land;

Δ = rate of depreciation of capital;

P_{Mi} = price of money in period i. Money in period 1 is the numeraire and hence has a price of 1;

x_{Mi} = holdings of money in period i;

P_{Bi} = discount price of a certificate of deposit in period i;

π_i = domestic rate of inflation in period i;

r_i, r_{Fi} = domestic and foreign interest rates in period i;

x_{Bi} = quantity of bank deposits, that is, CD's in period i;

e_i = exchange rate in terms of units of domestic currency per unit of foreign currency in period i;

x_{Bfi} = quantity of foreign currency held in period i;

TR_i = transfer payments from the government in period i;

a, b, α, β = estimated constants;

d_i = constants estimated from model simulations;

DEF = the value of nonperforming assets in the banking system;

$ASSET$ = total assets of the banking system; and

C = a functional form that depends negatively upon the ratio of nonperforming assets to total assets in the banking system.

The left hand side of equation (5a) represents the value of consumption of goods and leisure and financial assets. The next two equations contain the value of the consumer's holdings of capital and labor, as well as the principal and interest that the consumer receives from the domestic and foreign financial assets that he or she held at the end of the previous period. The equation $C_i = N_i$ then imposes a budget constraint in each period. Equation (5b) says that the proportion of savings made up of domestic and foreign interest bearing assets depends on relative domestic and foreign interest rates, deflated by the change in the exchange rate. Equation (5c) is a migration equation that says that the change in the consumer's relative holdings of urban and rural labor depends on the relative wage rates. Equation (5d) is a standard money demand equation in which the demand for cash balances depends on the domestic rate of inflation and the value of intended consumption. There is, however, one modification. The inflation elasticity, c, depends on the share of nonperforming bank assets in total assets. If there are no bad assets, then c takes its estimated value. As nonperforming assets rise, c declines.

In period 2 we impose a savings rate based on adoptive expectations, as in equation (5e). The constants (d_i) are estimated by a simple regression analysis, based on the previous periods. Thus if we are in period t, where t is the end of a two-period segment, then the closure saving rate for period t is determined by nominal income and the real interest rate. The constants are updated after each two-period segment by running a regression on the previous $t - 2$ periods.

Thus, savings rates are endogenously determined by intertemporal maximization in period t, but are determined by adoptive expectations in period $t+1$.[21]

When period $t+2$ begins, the consumer's holdings of financial assets may be different from those incorporated in the problem shown above, since defaults may have occurred. The consumer then optimizes again for periods $t+2, t+3$, based on his or her new, unexpected holdings of financial assets at the beginning of period $t+2$.

D. The Government

The government collects personal income, corporate profit, value-added taxes, and import duties. It pays for the production of public goods and subsidies. Unlike the government of a market economy, it also pays for investment in state enterprises and collects revenue from the returns to the capital of those enterprises. If the state enterprises incur losses, then the government subsidizes them. In addition, the government must cover both domestic and foreign interest obligations on public debt. The deficit of the central government in period 1, D_1, is then given by:[22]

$$D_1 = G_1 + S_1 + r_1 B_0 + r_{F1} e_1 B_{F0} - T_1 - \sum_{j=1}^{5} P_{Kj1} K_{Gj1} (1 - PRIV_{j1}) \qquad (6)$$

where S_1 represents subsidies given in period 1, G_1 is spending on goods and services, and the next two terms reflect domestic and foreign interest obligations of the government, based on its initial stocks of debt. T_1 represents tax revenues, and the final term represents the income from publicly owned capital that accrues to the government. The term $PRIV_{j1}$ represents the degree to which public capital in sector j is privatized in period 1. Thus if the sector were fully privatized we would have $PRIV_{j1} = 1$. Any partial privatization would be reflected by a value less than 1. The resulting deficit is financed by a combination of monetary expansion and domestic and foreign borrowing. If Δy_{BG1} represents the face value of domestic bonds sold by the government in period 1, and C_{F1} represents the dollar value of its foreign borrowing, then its budget deficit in period 2 is given by:

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[21]Since the only information the consumer has about the future is the real interest rate, adoptive expectations is, in this case, equivalent to rational expectations.

[22]As before, 1 denotes period i and 2 denotes period i+1.

$$D_2 = G_2 + S_2 + r_2(\Delta y_{BG1} + B_0 + r_{F1}\, e_2(C_{F1} + B_{F0}) - T_2 - \sum_{j=1}^{5} P_{Kj2}\, K_{Gj2}\,(1 - PRIV_{j2}) \quad (7)$$

where $r_2(\Delta y_{BG1}+B_0)$ represents the interest obligations on its initial domestic debt plus borrowing from period 1, and $e_2\, r_{F2}(C_{F1} + B_0)$ is the interest payment on the initial stock of foreign debt plus period 1 foreign borrowing. As before, the final term is the revenue from state enterprises after privatization.

The government finances its budget deficit through a combination of monetization, domestic borrowing, and foreign borrowing. We assume that foreign borrowing in period i, C_{Fi}, is exogenously determined by the lender. The government then determines the face value of its bond sales in period i, Δy_{BGi}, and finances the remainder of the budget deficit by monetization.[14] Hence:

$$D_i = P_{Bi}\Delta y_{BGi} + P_{Mi}\Delta y_{Mi} + e_i C_{Fi}$$

E. The Foreign Sector

The foreign sector is represented by a simple export equation in which aggregate demand for exports is determined by domestic and foreign price indices and world income. The specific form of the export equation is:

$$\Delta X_{no} = \sigma_1[\frac{\pi_1}{\Delta e_i + \pi_{Fi}}] + \sigma_2 \Delta y_{wi}$$

The left hand side of the equation represents the change in the dollar value of exports in period i, π_i is inflation in the domestic price index, Δe_i is the percentage change in the exchange rate, and π_{Fi} is the foreign rate of inflation. Also, Δy_{wi} represents the percentage change in world income, denominated in dollars. Finally, σ_1 and σ_2 are corresponding elasticities.

The combination of the export equation and domestic supply responses then determines aggregate exports. Demand for imports is endogenous and is derived from the domestic consumers' maximization problems. Foreign lending has not been modeled, but has been taken to be exogenous. Thus gross capital inflows are exogenous, but the overall change in reserves is endogenous. Finally, we will suppose that the exchange rate is fixed.

The supply of foreign reserves y_{FGi}, available to the government in period i is given by:

$$y_{FGi} = y_{FG(i-1)} + X_i - M_i + x_{F(i-1)} - x_{Fi} + C_{Fi}$$

Here x_{Fi} represents the demand for foreign assets by citizens of the home country, so $x_{F(i-1)} - x_{Fi}$ represents private capital flows. C_{Fi} represents exogenous foreign borrowing by the home government. Finally, changes in the money supply in period i, ΔM_{Si}, are now given by:

$$\Delta M_{Si} = \Delta y_{Mi} + \Delta OMO_i + e_i y_{FGi} - e_{i-1} y_{FG(i-1)}$$

where Δy_{Mi} is determined by the government financing its budget deficit, and ΔOMO_i represents money created through open market operations. The remainder of the right-hand side represents the domestic currency value of the balance of payments.[23]

F. Equilibrium in the Model

An equilibrium in our model is defined as market clearing in the markets for factors and financial assets, replicated in each time period. Factor markets are capital (five types), urban and rural labor, and land. Financial assets are currency, domestic bank deposits, and foreign currency. Hence there are 11 dimensions in each time period. Thus in the six period time horizon of our simulations, for example, there are a total of 77 dimensions over which we solve for market clearing prices and quantities. The dimension of the input-output matrix for intermediate and final production is essentially arbitrary, since we use a computational technique that generates Leontief prices and identical market clearing in intermediate and final markets, based on factor prices. We use a solution method that is based on an approximating fixed point algorithm to solve for the equilibrium.[24]

V. DATA SOURCES FOR CHINA

A variety of data sources for China are used to parameterize the model. These sources are described in this section.

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[23] We also permit sterilization of foreign reserve flows. This may be an important policy instrument in a country such as China, which has enormous stocks of foreign reserves.

[24] The solution is derived by the use of a computer program written by Andrew Feltenstein. The program is written in FORTRAN 90 and both the program and the Chinese data set are available from the authors.

The technology for intermediate and final production is given by the 1995 Chinese input-output matrix. This is taken from the 1998 *China Statistical Yearbook* and represents 1995 technology. The matrix has 17 sectors, which are as follows.

1. Agriculture
2. Mining
3. Foodstuff
4. Textiles
5. Other manufacturing
6. Production of electricity
7. Gas, coal and petroleum
8. Chemicals
9. Building materials and nonmetallic minerals
10. Metal products
11. Machinery and equipment
12. Construction
13. Transport and telecommunication
14. Commerce
15. Public utilities
16. Banking and insurance
17. Other services

To correspond to our different capital types, we have assumed that the 17 sectors are grouped into five aggregate groups. These are:

Sectors	Capital type
2	1
3-5	2
6-11	3
12-13	4
14-17	5

We derive indirect taxes from the input-output matrix, using the coefficient for net taxes on production. To derive import coefficients for the input-output matrix and import tariff rates, we take a somewhat involved approach. This approach is necessary since the Chinese input-output matrix does not include import coefficients. Here, as with all other derived data, we take our figures from 1995 in order to correspond to the input-output matrix. We assume that all inputs are used as intermediate and primary inputs to production, since we lack the information to derive imports used for final consumption. We use Table 16.5 from the 1998 *China Statistical Yearbook* to obtain sectoral imports for five sectors: (1) agriculture, (2) mining, (3) foodstuff, (4) textiles, and (5) other manufacturing. These are given in U.S. dollars, and we use an exchange rate of 8.35 yuan/$ to calculate domestic currency figures. Corresponding IO coefficients are then derived by dividing sectoral imports by the total inputs to sectoral production from the IO matrix.

We need to derive the effective rates of direct taxation for enterprises. Table 7.8 gives total revenues transferred to the government by state-owned enterprises and collectively owned enterprises. Table 2.10 gives total income from industry, and from this we derive a tax rate of 4.8 percent that is levied on inputs of capital and labor to all nonagricultural sectors. We also need government current and capital expenditures, as percentages of GDP. Nominal expenditure is

taken from Table 7.4, while nominal GDP comes from Table 2.13. From these we obtain a figure for capital expenditures of 2.9 percent of GDP, and for current expenditures on goods and services of 8.6 percent of GDP. We should note that this does not include interest payments, which are generated endogenously by the model.

To parameterize the consumer's problem, we need several types of data: utility weights for the different consumers demand functions and initial allocations of factors and financial assets. To derive utility weights, we use Table 3.18, the final use part of the IO matrix. This gives expenditures on each of the 17 sectors by agricultural and nonagricultural households. From these, we obtain utility weights for the two consumer categories. Behavioral parameters, such as those representing money demand and savings behavior, are taken from Feltenstein, Lebow, and Van Wijnbergen (1990) and Feltenstein and Ha (1991).

Initial allocations of capital are given by the sectoral operation surpluses, that is, returns to capital, from the IO matrix. Similarly, allocations of labor are given by compensation of laborers' across sectors. Thus we define a physical unit of capital and labor as that which earned one yuan in 1995. Initial allocations of money are taken from the IMF's *International Financial Statistics* (IFS) as M1 for 1994. Initial allocations of bank deposits are also derived from the IFS as 1994 holdings of quasi-money. Finally, we assume that there are no holdings by the two domestic consumer types of foreign currency. The initial holding of foreign currency by the rest of the world, that is, the foreign consumer is taken to be the 1994 value of exports. This, in turn, is taken from Table 16.3 of the *Statistical Yearbook.*

VI. SIMULATIONS

Since the model cannot be solved analytically, a numerical solution method is used based on parameters derived from the aforementioned data sources. This helps derive certain conclusions about the effect of alternative paths for the economy, corresponding to different assumptions on policy changes and reforms. A fixed-point that corresponds to an intertemporal equilibrium is derived. This equilibrium thus represents a set of prices in each period at which all factor and financial markets clear in each period.

A. Baseline Scenario

The baseline scenario assumes no reform actions are taken. Table 1 gives the macroeconomic outcomes over a six-year simulation period.

Table 1. China: Baseline Scenario

Period	1	2	3	4	5	6
Price level	100	111.6	123.7	137.5	147.4	177.6
Real GDP	100	107.6	114.5	123.1	131.1	140.3
Budget (in percent of GDP)	0.7	-0.2	-3.1	-3.3	-6.3	-6.0
Interest rate	1.8	3.4	4.7	11.3	9.9	14.8
Current account (in percent of GDP)	11.1	11.7	7.3	8.2	4.9	3.8
Utility of consumer 1 = 100, utility of consumer 2 = 100						

Under the baseline scenario, real GDP grows at an average annual rate of 7.0 percent over the period of the simulation. At the same time there is a 12.2 percent average inflation rate over the time period. If we compare the baseline scenario for the period 1995–2000 with historical Chinese data, the simulated real growth rate is slightly lower, while the simulated inflation rate is substantially higher. The budget and current account positions over the first four years of the simulation are reasonably close to Chinese historical outcomes. After four years the budget deficit is higher and the current account lower, largely because of our assumption of a fixed exchange rate. Nonetheless, the simulation can serve as a benchmark for our counterfactual cases for policies. We should note that our model does not predict historical outcomes in the way an econometric model would, since we impose constant values for a number of parameters that, in fact, changed over time. For example, we assume a constant exchange rate, while in reality the exchange rate varied. We assume that tax rates and spending patterns remain constant, unlike what actually happened. We also assume market clearing interest rates, while interest rates are administratively determined.

The simulated budget shows a slight surplus at the beginning, which then turns into a deficit and slowly deteriorates as the interest rate rises. Similarly, the external current account slowly deteriorates as the real exchange rate appreciates, since the nominal exchange rate is fixed. The last two lines in the table represent the utility levels of the two consumers, which are normalized to 100 for the baseline scenario.[25] We do not report the outcomes for the balance sheets of the banks, because our simulations do not generate non-performing loans. We also assume that there are no non-performing loans in the first period, an obvious abstraction from Chinese reality.

[25] The utilities are calculated as the present value of the stream of consumption over the time periods of the simulation. The consumer's rate of time preference is the discount factor.

B. Privatization

Two initial simulations are carried out in which privatization is introduced at different speeds. In the first, a gradual process of privatization occurs, while in the second complete privatization takes place in the first period. It is assumed that in carrying out privatization the capital of public state-owned enterprises is simply given to the private sector and that privatization is carried out uniformly across sectors. The model is simulated for six periods.

To simulate gradual privatization, it is assumed that 30 percent of state-owned enterprise capital is given to the private sector in period 1, 30 percent more in period 3, and the final 40 percent in period 5. Thus, in the last two periods of the simulation there is full privatization. The outcomes are given in Table 2.

Table 2. China: Gradual Privatization

Period	1	2	3	4	5	6
Price level	101.9	114.1	124.5	153.1	153.8	187.6
Real GDP	98.8	106.4	113.7	121.9	133.3	142.2
Budget (in percent of GDP)	1.7	0.7	-1.5	-2.0	-4.2	-3.9
Interest rate	4.0	6.8	10.7	14.0	12.4	20.9
Current account (in percent of GDP)	10.9	11.7	7.3	5.5	3.3	2.0
Utility of consumer 1 = 102.3, utility of consumer 2 = 90.5						

There are a number of differences compared with the baseline scenario. First, the price level is higher in all periods. As the public capital stock is privatized, a corresponding decline occurs in the rate of public investment, which is not fully picked up by the private sector. The resulting lower capital stocks cause the general price level to rise. Second, real GDP initially declines, due to the decline in aggregate investment. Over time, however, a more efficient distribution of sectoral investment by the private sector takes place, leading to an eventual rise in real GDP to above the baseline scenario in the last two periods. Third, the budget position improves, relative to the baseline scenario, as the loss in public revenue from privatization is more than made up by the reduction in public investment spending. Fourth, the current account deteriorates slightly, compared with the baseline scenario, in line with the increased appreciation of the exchange rate. Fifth, the nominal interest rate is higher, as private investment eventually increases in the new environment. Finally, the urban consumer is relatively better off than before, while the rural consumer is worse off. This is because the increase in interest rates has

created a positive wealth effect for the urban consumer, who owns relatively more financial assets than does the rural consumer. Accordingly, the urban consumer increases his demand, thereby driving up prices. The rural consumer suffers from the higher prices, and hence realizes a lower utility level.

Suppose that, instead of gradual privatization, an immediate full privatization takes place in period 1. Thus, all the capital of the state-owned enterprises is given to the private sector at the beginning of period 1. Table 3 gives the outcome of simulating a full privatization.

Table 3. China: Immediate Full Privatization

Period	1	2	3	4	5	6
Price level	112.6	136.2	132.5	161.6	155.2	188.6
Real GDP	95.2	102.3	116.6	124.3	138.0	146.7
Budget (in percent of GDP)	3.9	2.5	-1.7	-1.9	-6.1	-5.3
Interest rate	11.5	14.5	13.5	21.7	15.0	27.7
Current account (in percent of GDP)	9.4	7.8	5.0	3.6	2.1	1.1
Utility of consumer 1 = 108.5, utility of consumer 2 = 137.3						

A number of interesting observations compared with a process of gradual privatization can be made. First, inflation is significantly higher in the initial periods, with the price levels gradually converging under the two scenarios over the six periods. The higher inflation rates, particularly in the earlier periods, reflect the initial drop in capital and real GDP as the government's cutback on public investment is not picked up initially by the private sector. Second, real GDP further declines in the initial two periods, also because the elimination of public sector investment is not immediately made up for by a corresponding increase in private output. However, by period 3, the more efficient allocation of private, as compared with public, investment leads real GDP to rise beyond the level achieved under the gradual privatization scenario. Indeed, by period 6, real GDP is 3.2 percent higher than under gradual privatization. Third, the budget deficit deteriorates. This reflects the higher interest rates in this case, as compared with the previous case. These higher rates are themselves caused by the fact that all investment is now carried out by the private sector, starting in period 1. Since private investment is entirely financed by borrowing, unlike public investment, which may be partially financed by monetization, the increased borrowing drives interest rates up. Fourth, there is a further deterioration in the current account balance, as the higher inflation rates lead to a greater overvaluation of the currency under the fixed exchange rate. Fifth, both consumers realize higher levels of utility, as the overvaluation of the currency has a positive effect on consumption of both

consumers. We should note that the deterioration of the trade balance indicates that this higher level of consumption may not be sustainable in the long run.[26]

The basic conclusion of these two simulations is that, on balance, immediate privatization has a more positive impact on consumers than a gradual one. However, in both cases, the greater deteriorating trend of the current account relative to the baseline scenario, due to the increasingly overvalued exchange rate, raises questions of policy sustainability without adjusting the exchange rate.

C. Exchange Rate Policy

Given the increasingly overvalued exchange rate in the two privatization simulations, this section presents the results of simulations combining privatization with an adjustment in the exchange rate. To examine a "gradual-gradual" approach, assume there is a gradual devaluation along with a gradual privatization. Suppose that there is a 5 percentage point devaluation in each period starting with period 1, and that a gradual privatization is implemented consistent with the process shown in Table 2. The results are given in Table 4.

Table 4. China: Gradual Privatization and 5 Percent Annual Devaluation

Period	1	2	3	4	5	6
Price level	104.3	119.9	135.0	165.0	174.3	215.5
Real GDP	99.0	106.8	115.0	122.9	134.3	143.6
Budget (in percent of GDP)	1.6	0.5	-1.5	-2.2	-4.1	-4.0
Interest rate	5.2	7.2	11.2	13.6	12.6	18.9
Current account (in percent of GDP)	11.7	13.7	8.7	7.9	5.5	4.8

Utility of consumer 1 = 101.3, utility of consumer 2 = 99.1

There are several differences in this table compared with Table 2. First, the price level shows a significant increase, reflecting the effect of the devaluation. Second, real GDP shows marginal increase, due to the expenditure-switching effect of the devaluation. Third, the budget deficit is much the same, as the increased costs in foreign debt are balanced by increased revenues from import duties. Fourth, as expected, the current account balance improves, as the

[26] The long-run sustainability of the current account could be checked by running simulations over a considerably longer time period than the six periods examined in this study.

overvaluation is progressively corrected. Fifth, interest rates change little in nominal terms. Sixth, no significant changes occur in the utility levels of the urban and rural consumers.

Would the gradual privatization with up-front devaluation be more appropriate? Thus, instead of an annual devaluation or 5 percentage points, assume there is an initial 30 percent devaluation. Table 5 gives the results of the simulation.

Table 5. China: Gradual Privatization Plus 30 Percent Up-front Devaluation

Period	1	2	3	4	5	6
Price level	114.6	133.0	144.1	175.7	181.5	222.7
Real GDP	100.0	107.2	115.4	123.1	134.0	142.7
Budget (in percent of GDP)	1.1	-0.1	-1.7	-2.4	-4.2	-4.0
Interest rate	6.1	5.1	10.8	18.6	11.9	17.8
Current account (in percent of GDP)	15.1	14.8	10.0	8.4	5.3	3.8
Utility of consumer 1 = 100.0, utility of consumer 2 = 89.6						

Compared with Table 4, there is a small boost to real GDP, as the expenditure switching effect is higher. Second, as expected, inflation is initially higher, but it tapers off with the price levels under the two scenarios gradually converging. Third, the budget deficits and interest rates do not change much. Fourth, the current account position, at least in the initial periods, improves significantly relative to the previous scenario, because of the initial strong impact of the up-front devaluation, but worsens in the last two periods, as the devaluation effect is eroded by inflation. Fifth, because of the significantly higher price level and the unchanged real GDP, both rural and urban consumers end up being worse off than under the gradual devaluation scenario.

Let us now examine two possible combinations of immediate privatization—with a gradual devaluation and with an up-front devaluation. Table 6 gives the results of a gradual devaluation with immediate privatization.

Table 6. China: Immediate Privatization Plus 5 Percent Annual Devaluation

Period	1	2	3	4	5	6
Price level	117.3	143.7	143.6	177.9	175.1	216.6
Real GDP	95.3	102.5	117.2	125.0	139.3	148.2
Budget (in percent of GDP)	3.8	2.2	-1.8	-2.1	-5.9	-5.3
Interest rate	12.0	15.3	14.1	20.9	15.3	25.0
Current account (in percent of GDP)	9.6	9.0	6.4	5.7	4.3	3.7
Utility of consumer 1 = 106.9, utility of consumer 2 = 123.1						

It is useful to compare Table 6 with Table 4. There is a relative increase in inflation but a relative fall in real GDP in the first two periods, reflecting the greater fall in public investment. It is in the last four periods that private productivity catches up, resulting in a higher real GDP level and lower inflation. The budget improves initially, but starts deteriorating, because of the increase in the nominal interest rate. The real interest rate rises as private investment increases relatively, and the current account deteriorates as private consumption jumps. Both rural and urban consumers are better off than under the gradual privatization scenario.

Consider next a one-step devaluation at the beginning, together with an immediate privatization. The outcomes are given in Table 7. Compared with the previous scenario (Table 6), we see that the price level is generally higher and real GDP and the budget do not change much. Real interest rates are lower, as the up-front devaluation has reduced private investment more than in previous scenarios, thereby reducing borrowing requirements. In addition, the current account surplus improves marginally. The higher price levels, however, are reflected in lower welfare for both consumers.

Table 7: China: Immediate Privatization plus 30 Percent Initial Devaluation

Period	1	2	3	4	5	6
Price level	129.8	156.7	155.6	190.6	184.9	226.0
Real GDP	96.2	103.0	117.4	124.9	138.9	147.5
Budget (in percent of GDP)	3.1	1.7	-2.2	-2.4	-6.1	-5.5
Interest rate	12.5	14.3	13.3	19.2	14.2	24.0
Current account (in percent of GDP)	12.6	11.0	7.3	5.8	3.9	2.6

Utility of consumer 1 = 105.9, utility of consumer 2 = 114.2

D. Tariff Reform

We carry out two simulations on alternate tariff reform paths, involving a gradual and an up-front elimination of tariffs. The first simulation (Table 8) supposes that tariff reform is introduced gradually. Assume that, in the first two periods, tariff rates stay at their historical levels. In the remaining four periods, they are reduced by 20, 40, 70, and 100 percent of their initial values. Hence by period 6 they are at 0 percent. Table 8 gives the results of this simulation.

Table 8. China: Gradual Tariff Reform

Period	1	2	3	4	5	6
Price level	100	111.6	123.9	137.8	147.6	178.4
Real GDP	100	107.6	114.5	123.8	131.2	140.2
Budget (in percent of GDP)	0.7	-0.2	-3.2	-3.4	-6.6	-6.4
Interest rate	1.7	3.4	4.6	11.2	9.3	15.2
Current account (in percent of GDP)	11.1	11.7	7.3	8.3	5.0	3.8

Utility of consumer 1 = 99.1, utility of consumer 2 = 100.6

The second simulation assumes the elimination of tariff rates in the first period. The results are given in Table 9.

Table 9. China: Immediate Tariff Reform

Period	1	2	3	4	5	6
Price level	100.0	111.3	123.5	139.3	144.9	179.0
Real GDP	100.0	107.8	114.5	122.9	131.6	140.4
Budget (in percent of GDP)	0.4	-0.5	-3.5	-3.7	-6.7	-6.4
Interest rate	2.1	4.0	5.4	11.6	11.0	16.0
Current account (in percent of GDP)	11.5	12.3	7.6	8.1	5.4	3.6
Utility of consumer 1= 101.2, utility of consumer 2 = 101.3						

The outcomes in both simulations are essentially the same as those in Table 1. These suggest that tariff reform, taken alone, appears to have little impact, whether done gradually or in one step. We should, however, qualify our results. The effective average tariff rate that we have estimated is only 2.7 percent in period 1. Hence the elimination of tariffs would have relatively little impact on prices. At the same time, the coefficients of imports in the Chinese input-output matrix are quite small; in fact, imports are used as inputs to production in only 6 sectors. Accordingly, there is little link between imports and domestic production.[27]

E. Two Extreme Reform Packages

In this section two cases involving a multitude of policy instruments designed to illustrate the more complex cases of gradualism and shock approaches are considered. In both simulations, privatization, tariff reform, and devaluation are undertaken, the only difference being the speed with which these actions are taken.

Table 10 gives the results of a "big-bang" approach involving an up-front full elimination of tariffs, full privatization, and a 30 percent devaluation.

[27] Trade barriers in China are incorporated as nontariff barriers rather than as high tariff rates. Hence trade liberalization should really be studied as a reduction in quantitative restrictions. Such simulations, however, are beyond the scope of our current study.

Table 10. China: The Big-Bang Approach[1]

Period	1	2	3	4	5	6
Price level	130.4	157 .3	156.2	191.4	185.7	227.0
Real GDP	95.9	102.8	117.5	124.9	139.0	147.7
Budget (in percent of GDP)	2.4	1.4	-2.6	-2.8	-6.7	-6.0
Interest rate	12.4	14.6	13.7	20.2	14.9	25.4
Current account (in percent of GDP)	12.9	11.2	7.4	5.8	3.9	2.6

Utility of consumer 1 = 107.4, utility of consumer 2 = 116.4

[1] Immediate privatization, tariff reform and 30 percent devaluation.

These results provide an interesting contrast to the baseline scenario (Table 1) and indicate how the addition of tariff reform in a package affects welfare (compared with Table 6). First, compared with the baseline scenario, real GDP is lower in the two first periods, but then rises. The price level is higher throughout. After improving, the current account position deteriorates, as the once and for all effect of the devaluation gradually erodes. Overall, both consumers are better off, benefiting from the reform package. Second, the welfare effect of up-front tariff reform combined with other policies is somewhat greater than the up-front tariff reform alone.

Table 11 gives the results of a gradual approach to a reform package, involving gradual privatization, tariff reform, and devaluation phased in the same manner as in earlier simulations.

Table 11. China: The Gradual Approach[1]

Period	1	2	3	4	5	6
Price level	104.3	119.9	135.2	167.2	174.9	216.3
Real GDP	99.0	106.8	115.0	122.9	134.3	143.1
Budget (in percent of GDP)	1.6	0.5	-1.7	-2.3	-4.5	-4.4
Interest rate	5.2	7.2	11.2	13.9	12.8	19.6
Current account (in percent of GDP)	11.7	13.1	8.6	7.9	5.5	4.7

Utility of consumer 1 = 102.1, utility of consumer 2 = 100.0

[1] Gradual privatization, tariff reform, and devaluation.

Compared with the big-bang approach, this table indicates that gradualism, although resulting in less of a contraction in real GDP in the first two periods, yields lower real GDP levels in the subsequent periods. Partly because of that, both consumers are distinctly less well off in terms of their welfare than under the big-bang approach. In fact, the gradual approach results in minor welfare improvements relative to the baseline scenario only to the urban consumer.

VII. CONCLUSION

The results of the simulations (summarized in Table 12) illustrate the complexities of the issues involved in the speed of adjustment and sequencing of reforms. Much depends on the objectives being sought, the time frame, and the sustainability of the macroeconomic situation. The following conclusions can be drawn from the simulations.

First, if maximizing welfare over a specific period of time is the primary consideration, only a partial reform agenda would have to be pursued. The simulated model maximizes the welfare of *both* the urban and rural consumer only through a shock privatization. Whether the macroeconomic picture is sustainable beyond the specified time period is another issue. The worst external current account position in the last period is associated with the highest welfare result. This is because consumption of both sets of consumers benefit significantly from the overvaluation of the currency.

Second, a gradual approach to devaluation is preferable to a shock approach for maximizing welfare. Whether one looks at gradual or immediate privatization, the gradual devaluation generates higher welfare for both sets of consumers than does a shock devaluation. The reason is that gradual devaluation allows consumers to consume more for several initial periods—four in the case of the simulations—owing to the gradual reduction in the overvaluation. As a result, under the gradual devaluation there is less of an improvement in the external current account through the first four periods with only a marginal relative improvement in the last two periods. The same applies to gradual privatization. The gradual adjustment in the exchange rate results in worse current account outcomes in the first three periods, about the same in the fourth, but improvements in the last two periods

Third, in looking at complete policy packages, the big-bang approach is better in terms of welfare: both sets of consumers are better off under a package in which adjustment and reform policies reinforce each other. Although under the big-bang approach the drop in real GDP is initially greater than under the gradual approach, real GDP rises to higher levels in subsequent periods. However, the end-period current account position is better under the gradual approach, partly because of lower budgetary deficits and higher nominal interest rates for most of the period.

Fourth, if welfare considerations are ignored and improvements in the external current account are the only consideration, then a package of reforms introduced gradually becomes the "best" approach. In the case of the simulations carried out, this approach generates the best

Table 12. China: Summary of Simulations[1]

	Baseline	Gradual privatization	Immediate privatization	Gradual privatization and devaluation	Gradual privatization and up-front devaluation	Immediate privatization and devaluation	Immediate privatization and gradual devaluation	Immediate tariff reform	Gradual tariff reform	Big Bang	Gradual
U_1	100	102.3	108.5	101.3	100.0	105.9	106.9	101.2	99.1	107.4	102.1
U_2	100	90.5	137.3	99.1	89.6	114.2	123.1	101.3	100.6	116.4	100.0
Real GDP	140.3	142.2	146.7	143.6	142.7	147.5	148.2	140.4	140.2	147.7	143.1
Price level	177.6	187.6	188.6	215.5	222.7	226.0	216.6	179.0	178.4	227.0	216.3
Inflation	20.5	21.9	21.5	23.6	22.7	22.2	23.7	23.5	20.1	22.2	23.7
Budget	-6.0	-3.9	-5.3	-4.0	-4.0	-5.5	-5.3	-6.4	-6.4	-6.0	-4.4
Interest rate											
Nominal	14.8	20.9	27.7	18.9	17.8	24.0	25.0	16.0	15.2	25.4	19.6
Real	-5.7	-1.0	6.5	-4.7	-4.9	1.8	1.3	7.5	-4.9	3.2	4.1
External current account	3.8	2.0	1.1	4.8	3.8	2.6	3.7	3.6	3.8	2.6	4.7

[1]Last period, except for U_1 and U_2, which refer to the utility of the urban and rural consumers, respectively, over the periods simulated.

current account trajectory, but, by compressing consumption, it also significantly reduces the welfare of both sets of consumers.

Based on the simulation results, it is difficult to draw any major sequencing recommendations. The model and the simulations illustrate how difficult it is to tackle some real world sequencing considerations as those discussed in Section II of this paper. With caveats about the robustness of the conclusions on sequencing, the following points could be put forward.

First, a piece-meal approach to reform may not only fail to improve overall welfare significantly but may reduce it. Consider, in the case of the simulations, a gradual approach to privatization. It improves marginally the welfare of the urban consumer but leads to a sharp deterioration in the welfare of the rural consumer. Also, a gradual or immediate reduction in tariffs alone may not produce major welfare improvements.

Second, careful sequencing can improve welfare, and improper sequencing can hurt it. An immediate privatization with a gradual devaluation helps improve welfare more than an immediate privatization and devaluation or a gradual privatization and devaluation, both of which, in turn, are better than a gradual privatization and an up-front devaluation. In fact, the latter is worse for welfare than sticking to "unchanged" baseline policies.

Third, in sequencing, just like in speed, the criterion of improving the current account position over a set number of periods can produce different results. For example, in the simulations up-front privatization alone results in a lower external current account position in the last period than an overall gradualistic package, but maximizes the welfare of both sets of consumers. The catch, of course, is that the welfare gains may not be sustainable because the external current account deteriorates further in periods beyond the simulated time frame.

This paper illustrates clearly why the questions of speed of adjustment and sequencing of reform remain highly controversial in the economic literature. Depending on such factors as the model, the time frame, the phasing of policies, the policy packages, the financing, and the criteria used, different views can be supported. Thus, this clearly is an area where considerable further theoretical and empirical research is needed. In view of the multitude of factors involved, however, it may remain inconclusive. What is important is to understand the factors that need to be considered when deciding on the speed and sequencing of reforms. This paper has attempted to highlight some of these factors to provoke further research and discussion on the topic. If it succeeds in doing so, its main objective will have been achieved.

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