NBER WORKING PAPER SERIES

# LIBERALIZATION OF CAPITAL FLOWS IN KOREA: BIG-BANG OR GRADUALISM?

Dongchul Cho
Youngsun Koh

Working Paper 5824

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
November 1996

This paper was presented at the NBER East Asian Seminar on Economics in Hong Kong. This paper is part of the NBER's project on International Capital Flows which receives support from the Center for International Political Economy. We are grateful for the research assistance of In-Chul Kim and for the comments of Chong-Hyun Nam, Koichi Hamada, Anne Krueger, Stanley Black, Andrew Rose, and other participants of the seminar in Hong Kong. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

Liberalization of Capital Flows in Korea:
Big-Bang or Gradualism?
Dongchul Cho and Youngsun Koh
NBER Working Paper No. 5824
November 1996
JEL Nos. F4, F2, E6

## ABSTRACT

Capital market liberalization has become an irreversible trend in Korea since 1992. With the current level of high interest rate in Korea, however, drastic full-scale liberalization would certainly attract a large amount of capital inflows and appreciate the Korean won. This would affect the price competitiveness of Korean products in international markets, which could bring about significant macro-instability in an economy like Korea which relies heavily upon external transactions. Through simulations using a macro-model based on the neoclassical long-run convergence and the Keynesian short-run dynamics, this paper attempts to provide some quantitative assessments of several alternative policy choices including the speed of liberalization.

Dongchul Cho
Korea Development Institute
PO Box 113, Cheong Ryang
Seoul 130-012
KOREA

Youngsun Koh
Korea Development Institute
PO Box 113, Cheong Ryang
Seoul 130-012
KOREA

## I. INTRODUCTION

Economic liberalizations and deregulations have become a general trend in the era of globalization. The Korean economy is no exception to this trend. Despite the miraculous performances under the government-led growth strategy, Korea began to terminate some regulatory policies in the 1980s, and accelerated the liberalization process in the 1990s. With respect to external sectors of the economy, the Korean government introduced a market-based exchange rate system in 1990, and began to open the official capital markets in 1992 by partially allowing foreigners to invest directly in Korean stock markets. Since then, the process of capital market deregulations has become an irreversible trend. The only remaining matter seems to be how fast the liberalization process will, or should, be carried out.

With the current level of interest rate differentials between Korea and developed economies, drastic full-scale liberalization would certainly induce a large amount of capital inflows and appreciate the Korean won. This would affect the price competitiveness of Korean products in international markets, which could bring about significant macro-instability in an economy like Korea which relies heavily upon external transactions. An urgent question among Korean policy-makers is whether there exists any policy combination that could minimize the macro-instability associated with the unavoidable trend of capital market liberalization.

This paper attempts to provide some quantitative, though very

crude, assessments of several alternative policy choices. In order to perform simulation exercises, we set up a structural macro-model based on the neoclassical long-run convergence and the Keynesian short-run dynamics. Since the economic environments of the future, particularly in relation to the external capital transactions and the exchange rate determination, will be completely different from those of the past, there are undoubtedly limitations to which we can learn from past data.[1] For this reason, we employ theoretical relationships rather than only utilizing regression results for some parts of the model.

Section 2 reviews recent developments of the exchange rate system and capital market liberalization in Korea as well as the movements of some relevant macro-variables. Section 3 briefly explains the econometric macro-model used in this paper, and Section 4 presents the simulation results. Section 5 provides concluding remarks.

[1] As a leading example, one can think of Lucas critique (1976).

## II. CAPITAL FLOWS AND RELATED MACRO-VARIABLES IN KOREA

### 2.1 Exchange Rate System

With the abandonment of the fixed exchange rate system in 1980, the exchange rate began to float by being pegged to a basket of multiple foreign exchange rates. Nevertheless, the government continued to exercise a great discretionary power under the name of "policy considerations", the most important of which seemed to be the maintenance of the current account balance.[2]

It was recognized, however, that the operation with the exchange rate as an independent policy tool would not be possible since Korea's capital markets would no longer be insulated from the gigantic world capital market. To prepare for the forthcoming capital account liberalization process, the "Multiple Basket Peg System" was finally replaced in March, 1990, with the "Market Average Exchange Rate System". Under the new system, the exchange rate is determined by demands for and supplies of the Korean won vis-a-vis foreign exchanges, and the government can affect the exchange rate only indirectly through the market. Although the Korean government still appears to be a major player in the exchange market for the Korean won, its relative market power will certainly diminish as capital markets of Korea becomes integrated with the world market.

### 2.2 Capital Market Liberalization to Date

In Korea, capital market liberalization proceeded gradually,

---

[2] For details of Korea's exchange rate movements, see Oum and Cho (1995).

taking into account such factors as the current account balance, money supply, and exchange rate. For example, when the current account showed large deficits in the first half of the 1980s (see Figure 1), capital outflows were strictly restricted to slow down the pace of foreign debt accumulation. This situation was completely reversed in the latter half of the 1980s. A large amount of current account surplus, reaching 7.8 percent of GDP in 1988, forced the Korean government to decontrol capital outflows. As a result, the net level of foreign debt plunged from 37.7 percent of GDP in 1985 to 1.4 percent in 1989. But the increased capital outflows were insufficient in containing the growth of reserve money (see Figure 2). Hence, private credits were restricted, and massive sterilization was conducted through monetary stabilization bonds (MSBs).[3]

However, controls on capital flows became increasingly difficult as the Korean economy got more integrated into the global economy. Foreign investors, as well as domestic companies, constantly demanded a wider opening of Korean markets to exploit the big interest differential with overseas markets. To meet their demands to a certain degree, a capital account liberalization plan was finally announced in 1993.[4]

Korean residents now have a great deal of freedom as far as

---

[3] The outstanding MSBs amounted to 88 percent of the reserve money at the end of 1995.

[4] This plan was superseded by the Foreign Exchange Reform Plan in 1994, which in turn was revised in late 1995. Further liberalization was recently announced in April, 1996. For a survey of Korea's liberalization process, see Park (1995).

capital outflows are concerned.[5] But considerable restrictions still remain on capital inflows.[6] These restrictions on capital inflows are not expected to be removed in the near future unless the interest rate differential substantially narrows.

### 2.3 Capital Flows and Interest Rate Differential

Since external capital flows were tightly controlled in Korea, the capital account balance was extremely insensitive to the uncovered interest differential.[7] Using the actual rate of the won/dollar exchange rate depreciation as a proxy variable for the expected rate, $\log(e_{t+1}/e_t)$, Table 1 shows the results of the regressions of the capital account balance (normalized by potential GDP), $k_t$, on $i_t - i_t^f - \log(e_{t+1}/e_t)$, where $i_t$ and $i_t^f$ denote the domestic and foreign interest rates at time t, respectively. If capital were perfectly mobile across national borders and there were no uncertainty, this coefficient would in principle approach infinity so that only the exchange rate can, and should, adjust to restore

---

[5] Individuals, as well as institutional investors, can make unlimited investments in overseas securities. Institutional investors can hold deposits in foreign banks up to 100 million dollars, while lower limits apply to legal entities and individuals. Outward foreign direct investment (FDI) is going to be completely liberalized by next year.

[6] The regulations are as follows: non-residents as a whole can hold up to 20 percent of the outstanding shares of each company, and each non-resident up to 5 percent; bond-holding by non-residents is allowed indirectly through the Korea Trust and Country Fund; direct holding is allowed only for convertible bonds issued by small and medium enterprises; domestic companies can use foreign commercial loans within certain limits only for the import of capital goods and for FDIs; delayed payment for imports is currently permitted for up to 120 days.

[7] Since futures or forward markets are not yet established in Korea, we could not test covered interest parity.

the equilibrium.[8] While the short-term capital account ($skb_t$) shows a small but significant positive correlation, the long-term capital account ($lkb_t$) yields a negative correlation.

Although the correlations between the capital account and the uncovered interest rate differential are not strong, it seems clear that the capital account has become more responsive to the interest differential. As a piece of evidence, Table 1 reports the results of the regressions in which a linear time trend is included in the regression coefficient: the time trend appears significant in both $skb_t$ and $lkb_t$ regressions.[9] In particular, the estimates for the $kb_t$ regression imply that the coefficient turned to a positive number in 1991, approximately the same time that the stock market began to open to foreign investors.

### 2.4 Secular Trend of the Interest Rate

The annual yield rate of 3-year corporate bonds in Korea is still around 12 percent, which implies approximately 7 percent of real interest rate, given the approximately 5 percent of annual inflation rate. Under this circumstance, it is clear that, for foreign investors, Korea is an attractive market that has not yet been sufficiently explored. Then the most relevant question to our

---

[8] Considering the forecast error about $e_{t+1}$ at time t, there must be measurement errors in the expected appreciation rate, hence a downward bias in the regression coefficient. Nevertheless, there seems no reason to expect that this bias would change the sign of the coefficient estimate, and the increase in the coefficient estimate over time seems to indicate that the capital flows are getting more sensitive to the uncovered interest differential.

[9] We also tried several other specifications for the coefficient to test if there is any convexity over time, but the results were not very different from the linear time trend.

analysis in this paper is what maintains the high (real) interest rate in Korea and how it will evolve over time.

Figure 3 plots three series of interest rates: the official bank loan rate, the yield rate of 3-year corporate bonds, and the curb market rate, all of which are converted into real terms by subtracting the actual inflation rates. It is well known that the official interest rates on bank loans as well as corporate bonds were maintained at levels far below the market rate by severe government controls in Korea until the first half of the 1980s. Although the gap between the official rates and the curb market rate substantially narrowed down as a result of the continuous financial deregulations in the 1980s, the curb market rate seemed to be a better measure for the market rate at least until the first half of the 1980s. From Figure 3, it appears clear that the curb market rate has been in a downward secular trend from over 20 percent in the early 1970s to around 7 percent in 1995. Using the corporate bond rate, which is widely used as the representative market rate in the 1990s, we can also find a similar downward trend if the sample period is restricted to a recent period, say, 1983-1995.

We interpret this downward trend of the real interest rate as evidence for the transitional dynamics of the neoclassical growth model. In a stylized neoclassical growth model, employing the Cobb-Douglas production function, $Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}$, where Y denotes potential output, A the level of technology, K capital stock, and L the labor supply, the interest rate is equated to the marginal

productivity of capital, $\alpha Y_t/K_t$, subtracted by the depreciation rate, $\delta$. In an economy with the initial level of K/L lower than the steady state level, the marginal productivity of capital (hence interest rate) declines over time to converge to the steady state level (say, the world level of the interest rate).

In order to be convinced that the transitional dynamics was a plausible description for the secular trend of the Korean interest rate, we also plotted in Figure 3 rough estimates of $\alpha Y_t/K_t-\delta$ using $\alpha=1/3$ and $\delta=0.066$ per year,[10] which appear to aptly describe the trend of the curb rate. It may be worthwhile to note here that the average growth rate of investment has been far greater than the average growth rate of GDP in Korea since the 1960s.[11] This was the main cause of the declining trend of $Y_t/K_t$, and it seems unlikely that the trend will suddenly reverse its direction. In order to reflect the downward trend in the long-run, therefore, we include $\alpha Y_t/K_t-\delta$ in the interest rate specification along with other commonly used variables, such as money supply (see the Appendix for details).

---

[10] The estimates of labor income share, $1-\alpha$, in Korea range from 60 to 70 percent (see Table 2 in Hong (1994)) and the depreciation rate of capital, $\delta$, is estimated to be 6.6 percent per year by Park (1992).

[11] For example, the average annual growth rate of investment during the period of 1970-1995 in Korea is approximately 12 percent, while that of GDP is around 8 percent.

## III. A BRIEF DESCRIPTION OF THE EMPIRICAL MODEL

The model we used for the simulations is basically neoclassical in the long-run, but Keynesian in the short-run (details are in the Appendix). That is, all the real variables are determined by the supply side in the long-run, which follows the transitional dynamics explained in Subsection 2.4.[12] In the short-run, however, demand shocks do matter as in a typical Keynesian model.[13]

Technically, the way we distinguish the long-run from the short-run phenomena is by employing error correction types of specifications in which only the long-run determinants are included in the error correcting terms. That way, the effects of all the other short-run (say, stationary) disturbances eventually disappear, leaving only the effects of long-run determinants. For example, the interest rate is affected by many factors like money supply in the short-run, but it will eventually converge to the sum of the inflation rate and capital productivity. What then becomes important for the short-run effects is the speeds of convergence toward the long-run equilibrium levels, which we let the data determine from the regressions.[14]

---

[12] See Blanchard and Fischer (1989) for the discussion of dynamic responses of a flexible-price model in relation to the capital market opening of an economy with higher interest rates than the world rate. We take this case only as a long-run phenomenon because we assume in our model that prices are sticky in the short-run.

[13] While the long-run neutrality of money holds in the model, the super-neutrality does not.

[14] In a sense, our model can be viewed as a large vector autoregression system with error-correcting terms. To identify the shocks, we tried to minimize the number of two-way causal relations among contemporary variables. Nevertheless, a few contemporaneous variables remain to cause each other (e.g. consumption and GDP). We did not attempt to correct possible simultaneity bias, hoping that the size of the bias is of negligible magnitudes.

We used quarterly data from 1983.I through 1995.IV for the regressions,[15] although the simulation results will be presented in annual terms. For the future projection, we took the simplest case of the exogenous variables that are presented in Table 2. Particularly important is the foreign interest rate in real terms that we assumed to be 4 percent throughout the simulation period.[16]

We are aware of many limitations of our empirical model in particular as well as the simulation experiments in general. After all, the shortcomings of policy simulations using econometric models in general have well been recognized since Lucas (1976). Our model is also far from flawless. Perhaps the most important flaw is that the model is basically backward-looking. For example, the "expected" rate of inflation is simply computed from the past series of the inflation rate, rather than going through the rational expectations of the monetary policy reactions. Our application for forward-looking behavior to determine the exchange rate may then be considered inconsistent with the other parts of the model. Nevertheless, we hope that the following experiments can provide useful, though rough, quantitative assessment about the effects of capital market liberalization in Korea.

---

[15] The major reason that we restricted the sample period to 1983-1995 is to take the longest period in which the corporate bond rate can be used as the representative interest rate.

[16] Barro and Sala-i-Martin (1990), for example, report 3 to 4 percent per year as the acceptable range of the "world real interest rate". We took 4 percent to allow a slight margin for the country risk, so that the capital market will be in balance when the real interest rate in Korea reaches 4 percent.

## IV. SIMULATION RESULTS

### 4.1 A Benchmark Case: No Capital Flows

As shown in Figure 1, Korea has been maintaining net capital inflows by about 2 percent of GDP since 1992. Therefore, an abrupt shut-down of external capital markets may be interpreted as a regressive big-bang case. We experimented with this case to see how the model works, and to obtain the benchmark values of the relevant variables that will be compared with their dynamic paths under different regimes.

In this benchmark case, capital cannot flow to freely seek for higher returns, and thus the interest parity does not hold. Specifically, we let the exchange rate adjust to restore the current account balance by $e_{t+1} = e_t \, EXP(-\beta \, cb_t)$, where $cb_t$ is the current account balance normalized by the potential GDP and the parameter for the adjustment speed, $\beta$, was estimated from the data. That is, we assume that capital account transactions are just passively adjusted to support current account transactions. This specification of the exchange rate may be interpreted as a policy reaction function that aims at the current account balance using the current account performance as a measure of the exchange rate misalignment, which appears to fit Korean data in the 1980s.[17]

Although we will not report the results for this case, we could get a rough idea of the real exchange rate that would be consistent with the current account balance (called PPP rate, hereafter).

---

[17] In fact, the Korean government appeared to manage the exchange rate, aiming at the current account balance in the 1980s. See Oum and Cho (1995) for details.

Given the assumptions about all the exogenous variables, this value appears to be around 800 won per dollar in the beginning of 1996. In addition, we could confirm that the real interest rate gradually declines to 4.3 percent in 2005, which is mainly generated by the projection of the secular downward trend in the model (see the Appendix for details). It is also confirmed that the rate of CPI inflation converged to around 3 percent under the assumption of the money supply and the labor growth rate.

In the followings, the discussion will focus on the results of three cases that differ in the speed of capital market liberalization and the exchange rate policy. Table 3 summarizes the exchange rate dynamics and associated money supply mechanisms for each of the three cases, and Figures 4A - 4L report the simulation results.

### 4.2 Big-Bang

We envision that "perfect capital mobility" is the case in which the uncovered interest parity holds (or the elasticity of $kb_t$ with respect to $i_t - i_t^f - \log(e_{t+1}/e_t)$ is infinity in Table 1). In this case, the most active role is assigned to capital account transactions concerning the exchange rate determination, and the current account simply responds to the exchange rate movements. We assume that this new regime of the exchange rate dynamics suddenly replaced the old one at the beginning of 1996. As will be explained below, the only sustainable policy in this case is to let the exchange rate adjust.

4.2.1 Exchange Rate Adjustment

If the government let the exchange rate absorb the interest rate differential in the case of "big-bang", the exchange rate dynamics can be specified by,

$$e_{t+1} = e_t \, EXP(i_t - i_t^f),$$

while the money supply is controlled by the government. In order to pin $e_t$ down in the simulation, a terminal condition is needed as in other forward-looking dynamic models. We tried several values for the initial $e_t$ and picked the associated dynamic path of $e_t$ that yielded the most consistent results with the path of $i_t$ at the terminal year, 2005. Since $i_t$ almost converges to $i_t^f$ by 2005 (6.5 percent = 4 percent of real rate + 2.5 percent of inflation rate in this case), the real exchange rate should also converge to the PPP rate that was roughly calculated in the benchmark case.

A typical sticky-price monetary-model (Dornbusch (1976), for example) would predict the results for this case. The exchange rate initially jumps to appreciate by approximately 15 percent[18] and then gradually depreciates by the interest differential until it converges to the PPP rate around 2005 (Figure 4A). The interest rate declines faster than the benchmark case because of the more

[18] This estimate of 15 percent is roughly consistent with the result of a simple algebra using the interest parity and the long-run trend of real interest rate without considering feedback effects of all the other variables of the macro-model. From the observation that the real interest rate declines by approximately 0.3 percent point per year, the cumulative sum of interest differential can be roughly computed by $\Sigma_{t=0}^{10}(r_t - r^f_t) = 15$, for $r_t = 7.0 - 0.3t$ and $r^f_t = 4.0$.

active investment[19] and the resulting capital accumulation (Figure 4E). The potential output also increases rapidly (Figure 4H), but the economy goes through a short-run recession for the first 2-3 years (Figure 4G) due to the contraction of foreign demand that is caused by the exchange rate appreciation. Prices, particularly PPI which is far more affected by import prices, become very stable (Figures 4I and 4J). But the current account deficit reaches almost 5 percent of GDP in 1997 (Figure 4K) and then approaches the balance, rapidly accumulating (net) foreign debt to 15 percent by 1999 (Figure 4L).[20]

### 4.2.2 Exchange Rate Targeting

Policy-makers often fear the rapid accumulation of foreign debt, thereby seeking for exchange rate stability. To see the effects of this policy, therefore, we set the nominal exchange rate at 800 won/dollar, which appears to be approximately consistent with the current account balance at the beginning of 1996. Since the interest parity should hold in this big-bang case, the only way to support the nominal exchange rate stability ($e_{t+1}=e_t$ for all t) is to equate the domestic interest rate to the foreign rate ($i_t=i_t^f$ for all t).[21]

---

[19] More active investment is mostly induced by the relatively low interest rate.

[20] Net foreign debt is simply computed as the accumulation of the current account deficit.

[21] The reason that $i_t$ should be equal to $i^f_t$ is that we assumed perfect foresight of investors.

For the expansionary monetary policy to lower $i_t$ to the level of $i_t^f$, we could easily confirm unsustainability: the model exploded no later than 1998 with more than 100 percent of inflation.[22] The initial monetary expansion to set $i_t=i_t^f$ brings about inflation, hence $i_t$ begins to rise, which requires the accelerating monetary expansion to keep $i_t=i_t^f$. If the interest rate gap is not so wide and the gap is expected to narrow down soon by a third factor, then a temporary expansion of the money supply may be a reasonable choice. But Korea's current situation does not seem to be such a case. As a means of saving space, we did not report the results of this experiment.

Another, though arguable, way to lower $i_t$ may be to run an extremely large budget surplus.[23] From many regressions of the interest rate on the public bonds, however, we only found an extremely small and statistically insignificant elasticity. The interest rate equation in the Appendix is the one that yielded the largest elasticity with respect to the public bonds. Even with this largest elasticity, a simple calculation shows that the required amount of the outstanding bond reduction to equate $i_t$ to $i_t^f$ would be 30 to 50 percent of GDP, or 2 times larger than the current level of total government expenditure, which would be impossible to achieve.

---

[22] The model exploded no matter where the target level of the exchange rate is set.

[23] How sensible this statement is depends on whether the Ricardian equivalence holds.

### 4.3 Gradual Liberalization

A general consensus of the empirical literature seems that, while the covered interest parity holds, the uncovered interest parity does not exactly hold even among the countries maintaining the most liberalized capital markets.[24] Considering this empirical finding, it may be rather reasonable to assume that the elasticity of $kb_t$ with respect to $i_t - i_t^f - \log(e_{t+1}/e_t)$ is finite. Particularly for the case of Korea in which the capital markets are expected to open gradually, we assume that this elasticity (denoted f(t) below) will be increasing at a gradual pace over time:

$$kb_t = f(t) \{ i_t - i_t^f - \log(e_{t+1}/e_t) \},$$

where $f(t)>0$ for all t, $f'(t)>0$. One can regard the big-bang case as the limiting case in which f(t) goes to infinity from the beginning. We have experimented many specifications of f(t). As can be easily reasoned, the general rule of thumb is that the more rapidly f(t) increases, the closer the results are to the big-bang case: the initial appreciation of the exchange rate is larger, or the model is more likely to explode with the exchange rate targeting.

In this paper, we only present the results for $f(t) = 7.5/(2010-t)$, which is one of the most gradual processes we have tried, so gradual that the exchange rate targeting does not

---

[24] This may be due to either the risk-averse behavior of the investors and/or the "irrational" formulation of the agent's expectations, or something else. See Taylor (1994) for a recent survey.

explode. The rationale of this specification is that (a) the Korean government will completely open capital markets by the year 2010, when the Korean interest rate is expected to be sufficiently close to the world rate (f(t) goes to infinity for t=2010), and (b) f(1995) = 0.5 is close to the actual elasticity in 1995.[25]

While this specification is tractable, the most critical question behind this gradual process is how sustainable the gradualism itself would be under the potential threat of speculative attacks. The assumption that capital flows are only partially responsive to the interest rate differential hinges on the presumption that potential speculators are limited with the amount of foreign currency transactions. That is, the big proviso of a successful gradualism appears to be the controllability of the quantity of foreign currency inflows until the interest rate differential narrows down, say, by the year 2000.

### 4.3.1 Exchange Rate Adjustment

This case is basically the same as the case of big-bang with exchange rate overshooting, except for the magnitudes. The exchange rate determined by $e_{t+1} = e_t \, EXP\{i_t - i_t^f - kb_t/(7.5/(2010-t))\}$ initially jumps to appreciate to a relatively mild extent and then depreciates over time until it reaches the PPP rate (Gadualism(e) in Figures 4A and 4B). The directions of all the other results are the same as the big-bang case, but the magnitudes are smaller.

---

[25] In 1995, $kb_t$ was about 3 percent and the interest differential was about 6 percent.

4.3.2 Exchange Rate Targeting

Perhaps a more interesting case for the gradual liberalization is the one in which the government policy to fix the nominal exchange rate is sustainable. Since $kb_t$ is not only finite but rather insensitive to the interest rate differential, the government is given much larger room for policy-making.

We fixed the exchange rate at 800 won/dollar as in subsection 4.2.2, and let the central bank accommodate additional money demand to the same extent as the overall balance surplus. Since the level of the exchange rate initially yields approximately the current account balance (Gradualism(M) in Figure 4K), the money supply expands almost as much as the capital account surplus, which will inevitably generate faster inflation.

This inflation yields opposite effects on the subsequent money supply. On the one hand, it raises the nominal interest rate and thus more capital inflows, which increases the money supply. On the other hand, however, the inflation appreciates the real exchange rate and the current account turns into deficit, which decreases the money supply. The relative size of the two effects depends on the specification of f(t), but under the case of the very gradual liberalization, f(t) = 7.5/(2010-t), the latter effect dominates and the money supply declines (Figure 4C).[26] The monetary contraction then pushes the economy further into a deep recession, which is about to enter into recession in 1999 after the

[26] If f(t) is less gradual, the model explodes as in the case of big-bang with exchange rate targeting.

boom generated by the initial monetary expansion (Figure 4G). The deep recession further decreases the rate of inflation (Figure 4D), and the nominal interest rate finally drops below the world rate in 2001 (Figure 4E), which brings about capital flight out of the country, along with current account surplus from 2002 (Figure 4K). While the foreign debt accumulates less than the big-bang case (Figure 4L), the potential level of output is smaller (Figure 4H) and the economy goes through a similar magnitude of macro-instability in the opposite directions (Figure 4G).

Under this gradual liberalization plan and the expected downward trend of the interest rate, the sterilized intervention for the exchange rate stability appears to be sustainable as well as sensible for macro-stability.[27] In order to avoid the initial recession and current account deficit, however, the government should bear the burden of public debt. In other words, the external debt that would otherwise accumulate is replaced by the internal debt of the government (incurring higher interest rates). The benefit is gaining macro-stability, while the cost is foregoing opportunity to exploit foreign savings to enhance the potential capacity of the economy.

[27] As mentioned earlier, the effect of the government bonds on the interest rate is negligible.

## V. CONCLUSION

We have presented rough estimates of the dynamic paths for important macro-variables under several different liberalization scenarios. Fully admitting the limitations of our experiments, we believe that the experiments can provide more concrete ideas of where the economy will be heading for each case.

Among very many possible combinations of the policies, including the speed of market opening, we are not able to pick the "optimal" one that totally depends on the objective function of policy-makers. If the objective is simply to maximize the potential capacity of the economy with price stability, the big-bang in conjunction with the exchange rate overshooting should be recommended. But in this case, policy-makers have to convince people that a sweet boom will arrive after the painful recession for the initial couple of years, and that the current account will turn into surplus after, say, ten years.

Perhaps the time horizon here is too long for policy-makers, and even when based on economics criteria it is not clear whether maximizing the potential level at the expense of a recession is the best choice. If it is not, a gradual liberalization process can be recommended. A critical justification for gradualism is then the secular downward trend of the interest rate, and the key to a successful gradualism seems to be the controllability over the quantity of foreign currency inflows. In any case, however, we completely leave unanswered the question of: how gradual is "optimal"?

## REFERENCES


Barro, Robert and Xavier Sala-i-Martin (1990), "World Real Interest Rates," *NBER Macroeconomics Annual*, edited by O.J. Blanchard and S. Fischer, MIT Press.

Blanchard, Olivier, and Stanley Fischer (1989), Lectures on Macroeconomics, MIT Press.

Dornbusch, Rudiger (1976), "Expectations and Exchange Rate Dynamics," *Journal of Political Economy*, Vol. 84, December, pp.1161-76.

Hong, Sung-Duk (1994), "An analysis of the Factors for the Korean Growth: 1963-92," pp.147-178, *Korea Development Review*, Fall (in Korean).

Jwa, Sung-Hee (1992), "Capital Mobility in Korea Since the Early 1980s: Comparison with Japan and Taiwan," *KDI Working Paper*, No.9216.

Lucas, Robert E. (1976), "Econometric Policy Evaluation: A Critique," In Karl Brunner and Allan Meltzer (eds.), Carnegie-Rochester Conference Series, Vol.1, pp.19-46.

Oum, Bong-Sung and Dong-Chul Cho (1995), "Korea's Exchange Rate Movements in the 1990s: Evaluations and Policy Implications," Presented at the KDI Symposium on Prospects of Yen-Dollar Exchange Rates and Korea's Exchange Rate Policy, Korea Development Institute.

Park, Woo-Kyu (1992), "A Research on Macro-Policy in Korea", KDI Research Paper Series 92-01, Korea Development Institute (in Korean).

Taylor, Mark P. (1995), "The Economics of Exchange Rate," *Journal of Economic Literature*, March, pp.13-47.

Table 1: Capital Flow and Uncovered Interest Rate Differential

| | constant ($\times 10^{-2}$) | $i_t - i_t^* - \log(e_{t+1}/e_t)$ | | $R^2$ |
|---|---|---|---|---|
| | | no time-trend | t-1995 | |
| $skb_t$ | -0.03 | 0.04 | | 0.06 |
| | (0.13) | (1.81) | | |
| $lkb_t$ | 1.26 | -0.11 | | 0.12 |
| | (2.83) | (2.63) | | |
| $kb_t$ | 1.23 | -0.07 | | 0.04 |
| | (2.38) | (1.47) | | |
| $skb_t$ | -0.13 | 0.09 | 0.01 | 0.11 |
| | (0.54) | (2.45) | (1.69) | |
| $lkb_t$ | 0.88 | 0.09 | 0.04 | 0.32 |
| | (2.15) | (1.33) | (3.76) | |
| $kb_t$ | 0.76 | 0.18 | 0.04 | 0.29 |
| | (1.63) | (2.39) | (4.14) | |

Notes: $skb_t$, $lkb_t$, and $kb_t$ denote short-term, long-term, and total capital account balance (normalized by potential GDP), and $i_t$, $i_t^f$, and $e_t$ denote domestic interest rate (yield rate of 3-year corporate bond), foreign interest rate (3-month Euro-Dollar rate), and won/dollar exchange rate, respectively. The sample period is 1983:I to 1995:IV, and numbers in parentheses are t-statistics. The linear time trend, t-1995, is normalized so that t=1995 yields 0. For further details, see the text.

Table 2: Assumptions about the Growth Rates of the Exogenous Variables

(unit: %)

| | Big-Bang (e) | Gradualism (e) | Gradualism (M) |
|---|---|---|---|
| $Y_t^f$ | 3.0 | 3.0 | 3.0 |
| $P_t^f$ | 2.5 | 2.5 | 2.5 |
| $i_t^f$ | 7.5 | 7.5 | 7.5 |
| $L_t^*$ | 2.2 | 2.2 | 2.2 |
| $e_t$ | - | - | 800 |
| $\bar{M}_t$ | 14.0 (1996-2000) | 14.0 (1996-2000) | - |
| | 13.0 (2001-2005) | 13.0 (2001-2005) | - |
| $\bar{B}_t$ | 14.0 (1996-2000) | 14.0 (1996-2000) | - |
| | 13.0 (2001-2005) | 13.0 (2001-2005) | - |

Note: See the Appendix for the definitions of the variables.

Table 3: Exchange Rate and Money Supply Determination Mechanism

| | Exchange Rate ($e_t$) | Money Supply ($M_t$) |
|---|---|---|
| **Big-Bang (e)** | $e_{t+1} = e_t \, EXP(i_t - i_t^f)$ | $M_t = \bar{M}_t$ (exogenous) |
| **Gradualism (e)** | $e_{t+1} = e_t \, EXP\{i_t - i_t^f - kb_t/(7.5/(2010-t))\}$ | $M_t = \bar{M}_t$ (exogenous) |
| **Gradualism (M)** | $e_t = 800$ | $M_t = \bar{M}_t + 5(KB_t + CB_t)$ |

Note: We used 5 as the money multiplier in the $M_t$ specification of the Gradualism.

Figure 1: External Balances as Percentage of GDP

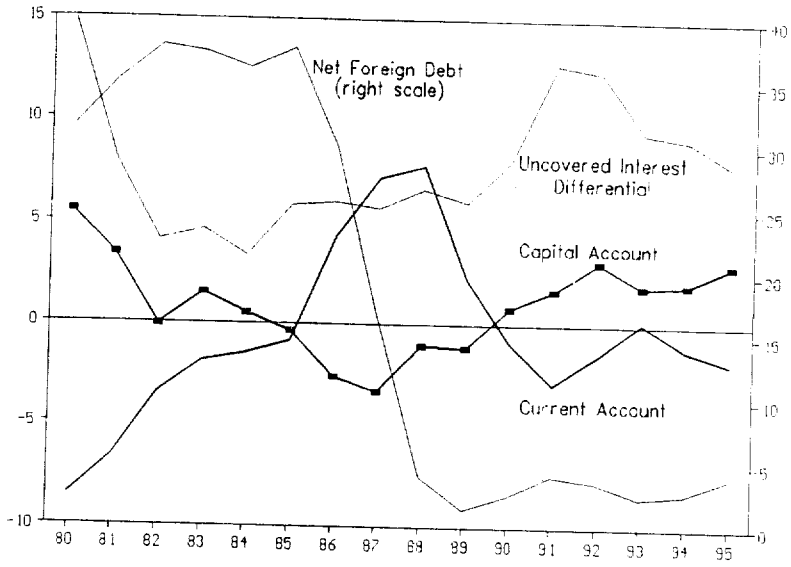



Figure 2: Annual Monetary and CPI Growth Rates in Percent

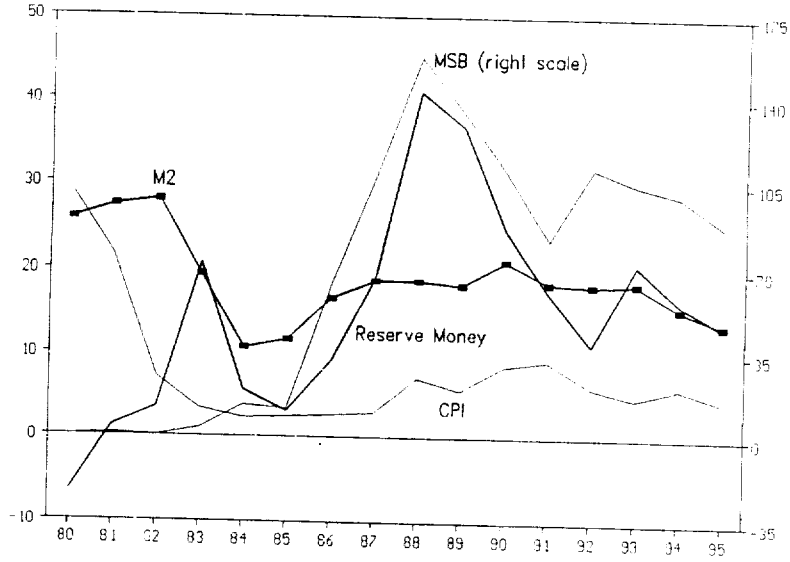


Figure 3: Trend of Real Interest Rate (%)

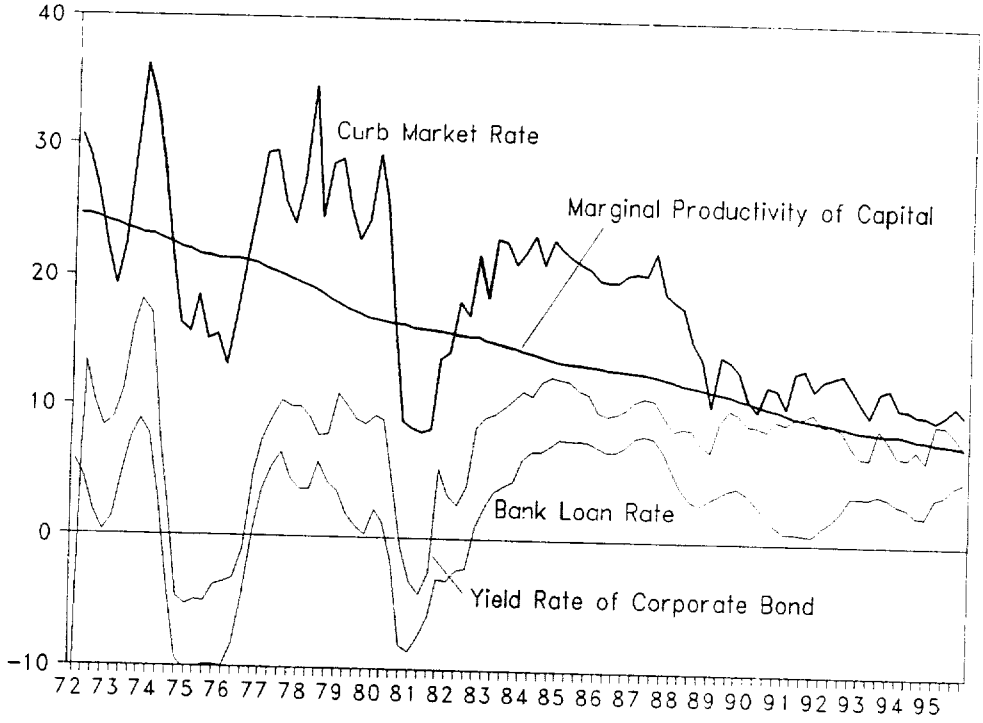


Figure 4A: Exchange Rate (won/dollar)

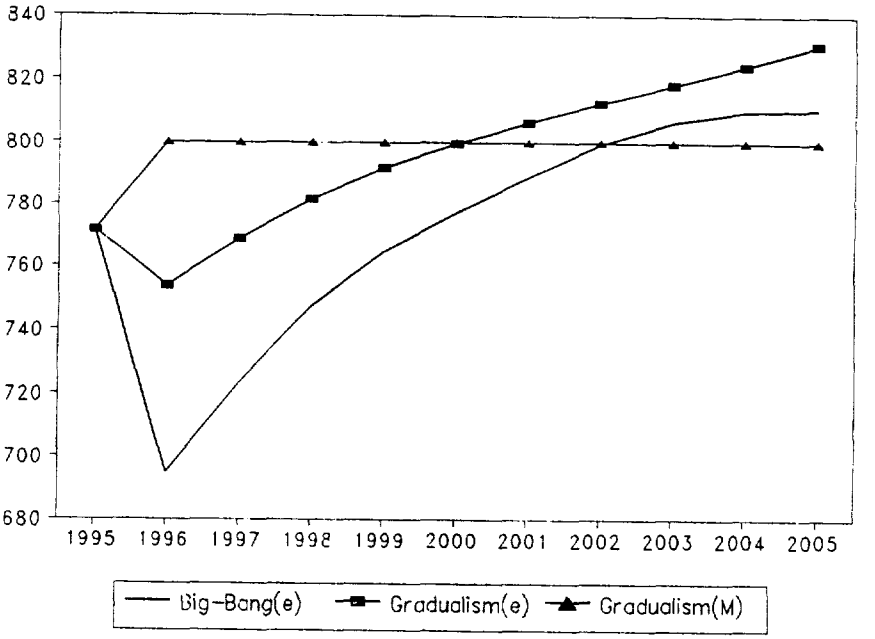



Figure 4B: Real Exchange Rate (won/dollar in 1990 prices)

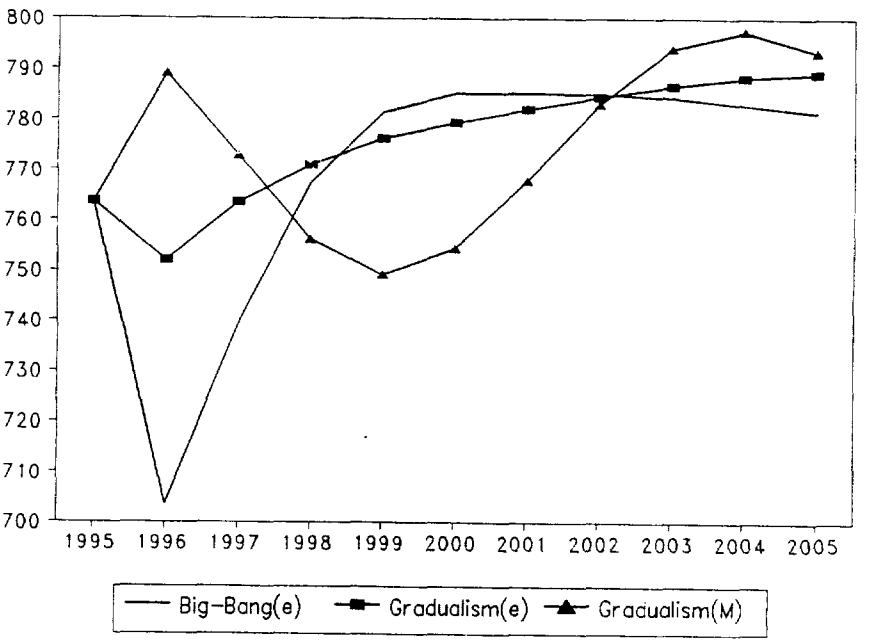


Figure 4C: Growth Rate of Money (%)

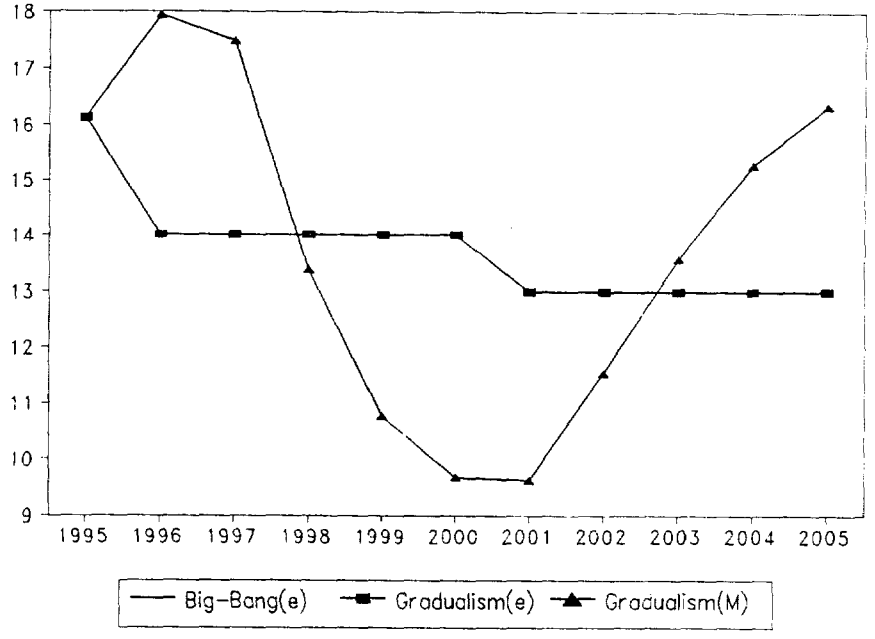



Figure 4D: Rate of CPI Inflation (%)

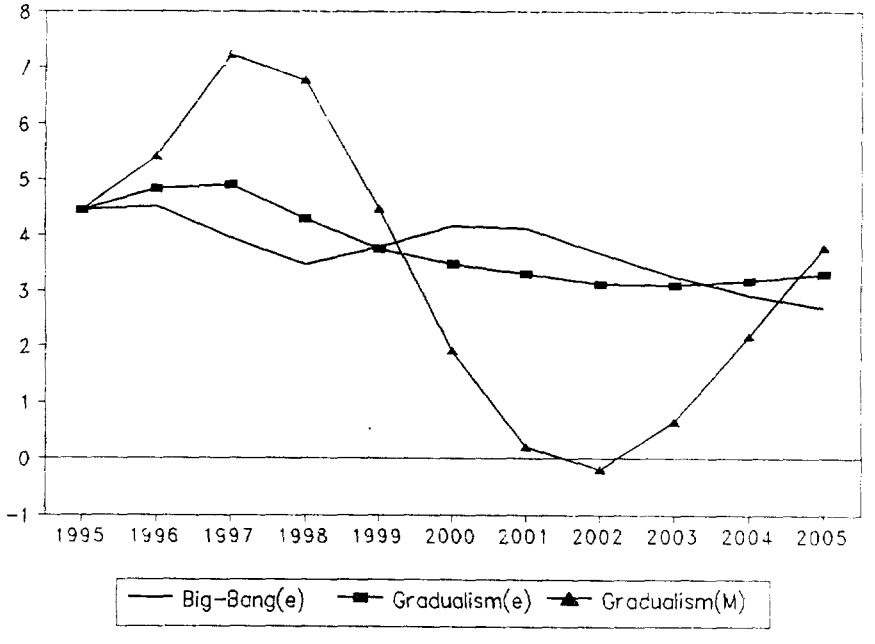


Figure 4E: Nominal Interest Rate (%)

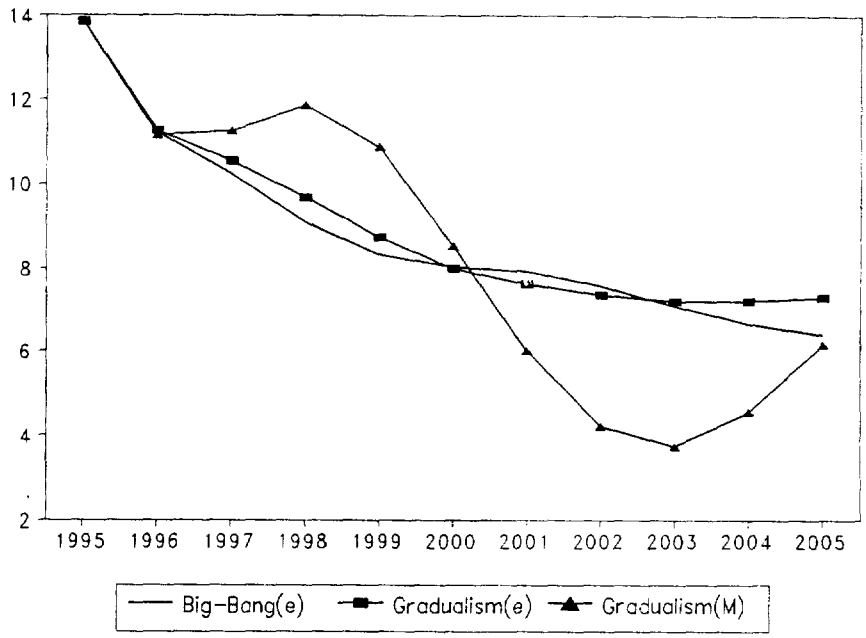



Figure 4F: Real Interest Rate (%)

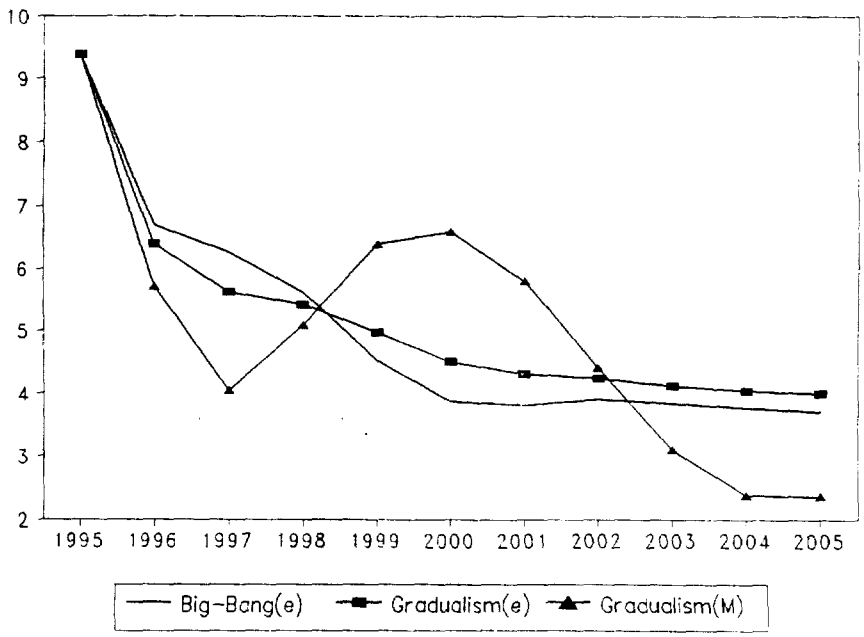


Figure 4G: GDP (Deviation from the Benchmark, %)

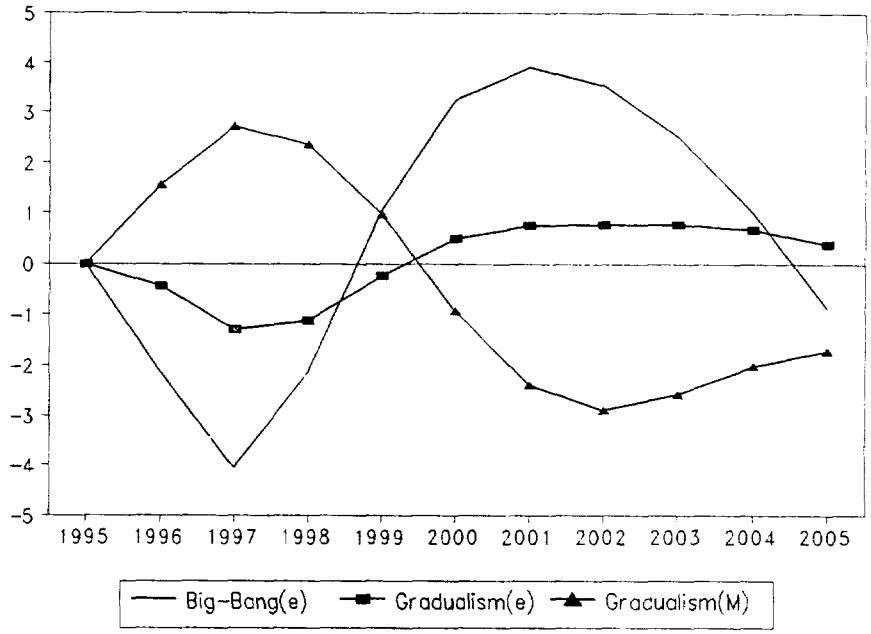



Figure 4H: Potential Output (Deviation from the Benchmark, %)

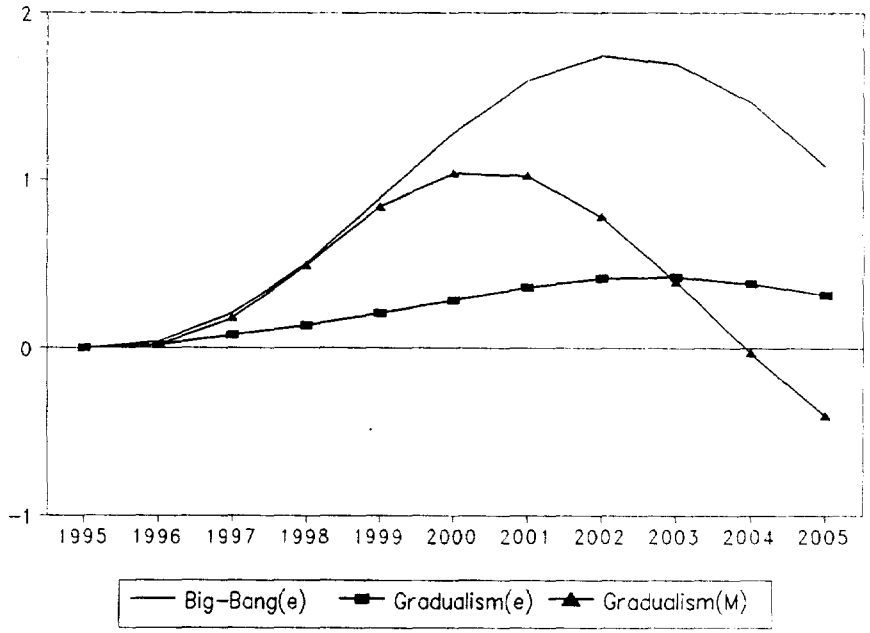


Figure 4I: CPI (Deviation from the Benchmark, %)

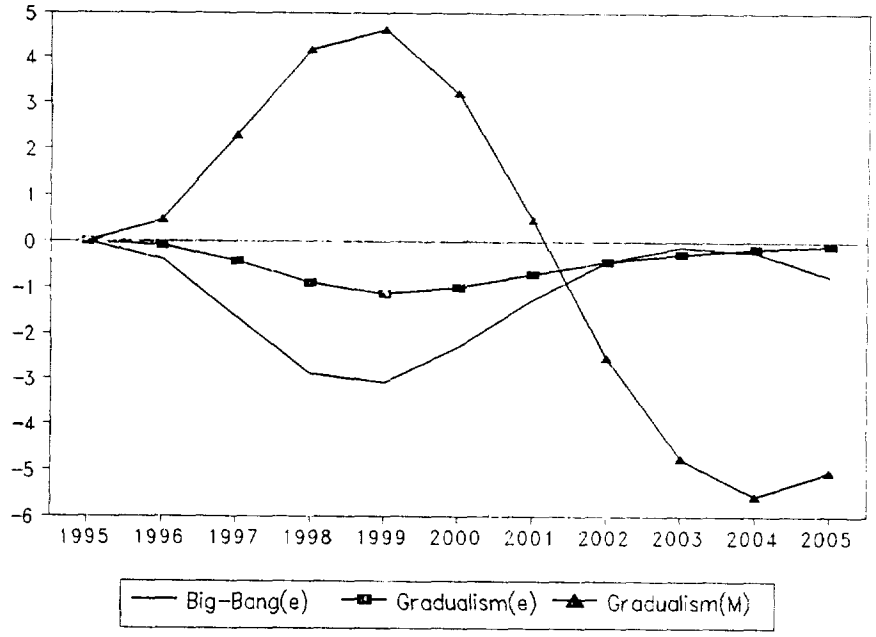



Figure 4J: PPI (Deviation from the Benchmark, %)

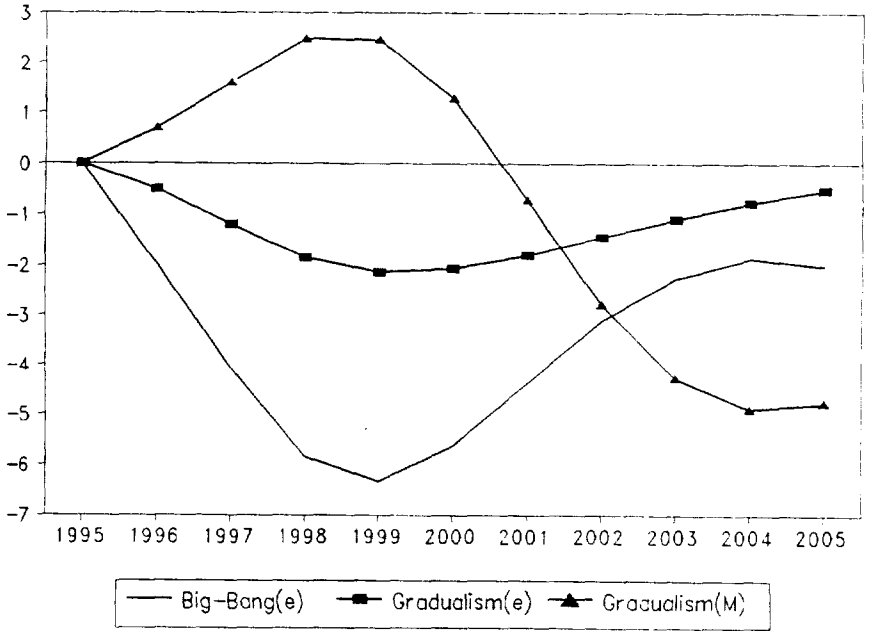


Figure 4K: Current Account Balance to GDP Ratio (%)

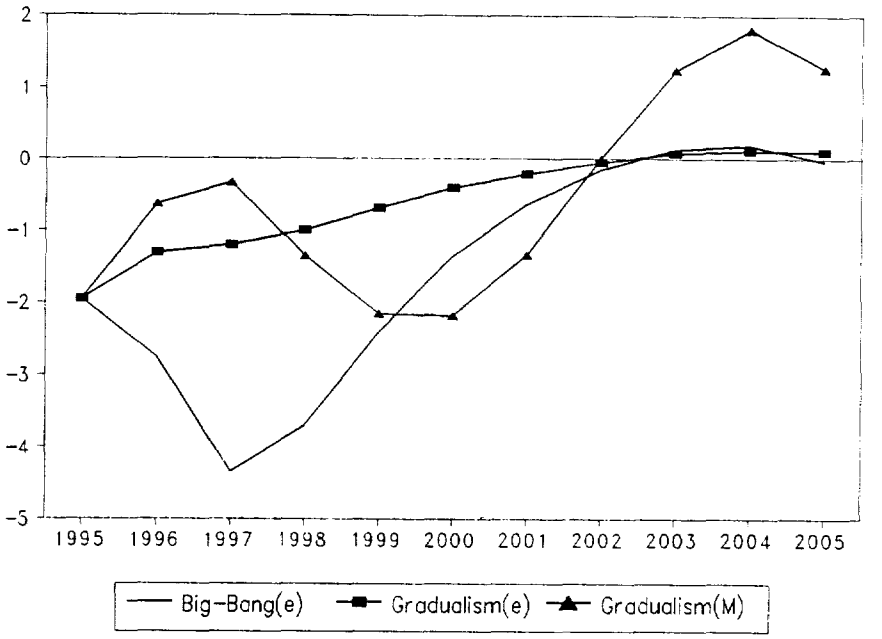
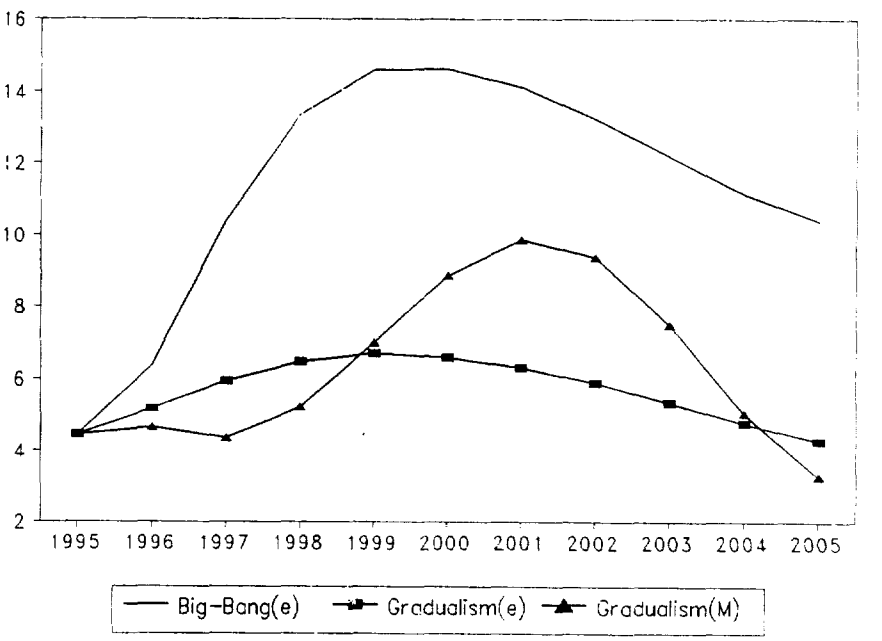



Figure 4L: Net Foreign Debt to GDP Ratio (%)



# APPENDIX: THE MODEL

| Variable | Content |
|---|---|
| A | technical level |
| B | public bond |
| $C^G$ | government consumption expenditure |
| $C^P$ | private consumption expenditure |
| e | exchange rate |
| I | gross fixed capital formation |
| KB | capital balance |
| K | capital stock |
| L | total labor employed |
| M | money supply (M2) |
| MG | imports |
| MPK | marginal productivity of capital |
| MPL | marginal productivity of labor |
| $P^c$ | consumer price index |
| $P^p$ | producer price index |
| $P^x$ | unit value index of exports |
| $P^M$ | unit value index of imports |
| $P^f$ | foreign wholesale price Index |
| $P^o$ | unit import price of oil |
| i | interest rate |
| $i^f$ | foreign interest rate |
| t | time trend (quarterly period) |
| W | wage |
| XG | exports |
| Y | gross domestic product |
| $Y^f$ | foreign GDP |
| $\pi$ | CPI inflation rate |
| $\tau$ | tax rate |

Notes: 1) * denotes potential level.
2) $\Delta$ denotes first difference.

**IDENTITIES**

Definition of Capital Stock (Annual Depreciation Rate of 0.066):

$$K_t = (1-0.066/4)\ K_{t-1} + (1/4)(I_t+I_{t-1}+I_{t-2}+I_{t-3})$$

Trend of Labor Force (Annual Increase Rate of 0.028):

$$L_t = EXP(0.02837 \cdot t/4 - 46.6687)$$

Aggregate Production Function (Capital Income Share of 1/3):

$$Y_t^* = A_t \cdot K_t^{1/3} \cdot L_t^{2/3}$$

Technology Progress Rate (Annual Increase Rate of 0.022):

$$A_t = EXP(0.02254 \cdot t/4 - 44.9738)$$

Productivity of Labor:

$$MPL_t = (2/3)\ Y_t^*/L_t$$

Productivity of Capital (4 to be annualized):

$$MPK_t = (4/3)\ Y_t^*/K_t$$

Trend of Capital Productivity[1]:

$$MPK_t^* = 0.10 + (4/3)\ EXP(-0.06447 \cdot t/4 + 125.355)$$

Trend of Capital Stock[2]:

$$K_t^* = [\ (3/4)\ A_t/MPK_t^*\ ]^{3/2} \cdot L_t$$

Trend of Consumer Price Level:

$$P_t^* = (M_t/Y_t^*)\ EXP(-0.03157 \cdot t/4 + 67.0944)$$

Definition of the Inflation Rate:

$$\pi_t = \log(P_t^C/P_{t-4}^C)$$

Definition of GDP:

$$Y_t = C_t^P + C_t^G + I_t + XG_t - MG_t$$

Notes: 1) This is obtained by regressing $\log(MPK_t-0.10)$ on t so that $MPK_t$ and the real interest rate converge to 10 percent and 3.4 (=10.0-6.6) percent, respectively.

2) $K_t^*$ is determined by the exogenous time trend alone.

**REGRESSION EQUATIONS**[1)]

$$\Delta\log(C_t^p) = \underset{(8.09)}{0.26}\cdot\Delta\log((1-\tau_t)Y_t) + \underset{(1.70)}{0.17}\cdot\Delta\log(M_t/P_t^C) - \underset{(2.23)}{0.09}\cdot[\ \log(C_{t-1}^p/Y_{t-1})\ ] - \underset{(2.27)}{0.06}$$

$$\Delta\log(I_t) = -\underset{(2.65)}{0.31}\cdot\Delta\log(I_{t-1}) + \underset{(1.98)}{0.26}\cdot\Delta\log(XG_t) + \underset{(1.10)}{0.29}\cdot kb_t - \underset{(1.44)}{0.53}\cdot(i_t-\pi_t-MPK_t) - \underset{(1.34)}{0.30}\cdot[\ \log(K_{t-1}/K_{t-1}^*)\ ] - \underset{(7.04)}{0.28}$$

$$\Delta\log(XG_t) = \underset{(2.33)}{0.30}\cdot\log(P_{t-2}^f/P_{t-2}^x) - \underset{(2.11)}{0.16}\cdot[\ \log(XG_{t-1}) - \underset{(36.75)}{3.04}\cdot\log(Y_{t-1}^f)\ ] - \underset{(9.73)}{0.12}$$

$$\Delta\log(MG_t) = \underset{(1.72)}{0.21}\cdot\Delta\log(I_t) + \underset{(2.32)}{0.27}\cdot\Delta\log(I_{t-1}) + \underset{(0.83)}{0.64}\cdot\Delta\log(C_t^p+C_t^G) + \underset{(1.19)}{0.17}\cdot\Delta\log(XG_t) - \underset{(1.83)}{0.24}\cdot\log(e_t\cdot P_t^M/P_t^p) - \underset{(2.03)}{0.15}\cdot[\ \log(MG_{t-1}/XG_{t-1})\ ] + \underset{(1.92)}{1.67}$$

$$i_t = \underset{(11.51)}{0.79}\cdot i_{t-1} + \underset{(1.51)}{0.02}\cdot\Delta\log(I_t) - \underset{(1.98)}{0.12}\cdot\Delta\log(M_{t-1}/P_{t-1}^c) - \underset{(1.31)}{0.01}\cdot\log(M_{t-1}/B_{t-1}) + \underset{(3.03)}{0.21}\cdot[\ (\pi_{t-1}+MPK_{t-1}-0.066)\ ] + \underset{(0.04)}{0.0002}$$

$$\Delta\log(W_t) = -\underset{(2.43)}{0.34}\cdot\Delta\log(W_{t-1}) + \underset{(3.34)}{0.35}\cdot\log(Y_t/Y_t^*) - \underset{(1.42)}{0.05}\cdot[\ \log(W_{t-1}/P_{t-1}^c) - \log(MPL_{t-1})\ ] + \underset{(1.31)}{0.36}$$

$$\Delta\log(P_t^c) = \underset{(1.54)}{0.19}\cdot\Delta\log(P_{t-1}^p) + \underset{(3.39)}{0.09}\cdot\log(Y_t/Y_t^*)$$

$$- \underset{(1.97)}{0.07}\cdot[\ \log(P_{t-1}^c/P_{t-1}^*)\ ] + \underset{(11.07)}{0.02}$$

$$\Delta\log(P_t^p) = \underset{(1.82)}{0.04}\cdot\Delta\log(W_{t-1}/MPL_{t-1}) + \underset{(4.01)}{0.39}\cdot\Delta\log(P_t^c)$$

$$+ \underset{(4.23)}{0.12}\cdot\Delta\log(e_t\cdot P_t^M)$$

$$- \underset{(2.49)}{0.09}\cdot[\ \log(P_{t-1}^p) - \underset{(3.53)}{0.26}\cdot\log(P_{t-1}^c) - \underset{(13.53)}{0.74}\cdot\log(e_{t-1}\cdot P_{t-1}^M)\ ]$$

$$- \underset{(2.14)}{0.004}$$

$$\Delta\log(P_t^x) = \underset{(2.26)}{0.05}\cdot\Delta\log(XG_t) + \underset{(3.56)}{0.60}\cdot\Delta\log(P_t^p/e_t)$$

$$- \underset{(1.37)}{0.11}\cdot[\ \log(P_{t-1}^x) - \underset{(17.61)}{0.85}\cdot\log(P_{t-1}^p/e_{t-1})\ ] + \underset{(0.73)}{0.002}$$

$$\Delta\log(P_t^M) = \underset{(3.02)}{0.46}\cdot\Delta\log(P_t^f) + \underset{(3.43)}{0.08}\cdot\Delta\log(P_t^o) + \underset{(2.50)}{0.40}\cdot\Delta\log(P_{t-1}^p/e_{t-1})$$

$$- \underset{(2.18)}{0.17}\cdot[\ \log(P_{t-1}^M) - \underset{(49.51)}{0.82}\cdot\log(P_{t-1}^f) - \underset{(10.74)}{0.18}\cdot\log(P_{t-1}^o)\ ]$$

$$- \underset{(0.27)}{0.001}$$

Notes: 1) Seasonal Dummies were included, but not reported. Numbers in parentheses are t-statistics and the variables in brackets are error correcting terms.