'UNPRODUCTIVE' CREDIT AND THE SOUTH-KOREAN CRISIS

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ABSTRACT

We provide a novel empirical analysis of the South Korean economy that reveals large volumes of excess or 'unproductive' credit since the late 1970s, indicating that a sizeable proportion of total credit was used to refinance unprofitable projects. Our findings are consistent with the hypotheses of 'overlending' and 'overinvestment', which may reflect soft budget constraints and/or moral hazard. We argue that while these weaknesses were not on their own responsible for the financial crisis, their interaction with the risks emanating from capital account liberalisation created fertile ground for financial panic.

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1. Introduction

The 1997 financial crisis in South Korea took the economics profession by surprise. After all, not so long ago the main focus of most studies on Asian economies, including Korea, was the explanation of the 'miracle' (e.g. World Bank, 1993; Young, 1995; Demetriades and Luintel, 1996). Enjoying growth rates of around 8% for more than three decades, South Korea managed to transform itself from a poor, largely agricultural, country to a buzzing export-oriented industrialised state, with standards of living comparable to those of many western nations. Equally impressive this was achieved through mobilisation of domestic resources, with the government controlled banking system in the centre of financing exceptionally high rates of capital accumulation, without significant budget deficits or inflation rates (Park and Kim, 1994).

The remarkable macroeconomic performance of South Korea essentially rules out the traditional fundamental view of 'first-generation' crisis models as a plausible explanation of the South Korean crisis. These models (e.g. Krugman, 1979) ascribe crises to macroeconomic imbalances, reflected mainly in large current account and fiscal deficits. While there is some evidence of a growing current account deficit before the crisis – reflecting a slowdown in exports due to the contraction of the Japanese economy, the appreciation of the exchange rate and the collapse of the world price of semi-conductors – these deficits were generally perceived to be benign, as they were covered by capital inflows which funded long-term investment (Glick, 1999).

A new variant of the 'fundamentals' view emphasises the role of weak financial fundamentals and moral hazard in creating fertile ground for financial crises. In this regard, the close relations between government, banks and industry, typical of many Asian countries, are now widely thought responsible for moral-hazard behaviour, reflecting the existence of (explicit or implicit) government safety nets. This led to 'bad banking' practices, which took the form of excessive lending and over-investment in low productivity projects (e.g. IMF, 1997; Krugman, 1998).

There are a number of theoretical models that explain how weak financial fundamentals can lead to a crisis. McKinnon and Pill (1997), for instance, argue that in an inadequate regulatory framework, banks can inflate entrepreneurs' expected payoffs, knowing that in case of default the government will be forced to bail out distressed borrowers. The entrepreneurs, lacking sufficient information to assess banks' signals, tend to consider them as correct. As a result, they bid eagerly for funds and a lending-investment boom ensues. Corsetti, Pesenti and Roubini (1999) develop a model in which a financial crisis erupts as a result of potential future fiscal deficits that are implied by moral hazard behaviour in private corporate and financial investment. The latter leads to over-

investment, which can persist for as long as domestic firms are able to refinance their unprofitable projects and cash shortfalls through foreign borrowing, a process known as evergreening. Only when international reserves fall below a certain threshold [2], foreign investors' willingness to roll-over credit would cease, causing a financial crisis. In a similar vein, Huang and Xu (1999) argue that over-investment was due to soft-budget constraints, which enabled large industrial Korean conglomerates (chaebols) to have a continuous access to secure and subsidised policy loans. In a soft-budget constraint economy, there is no mechanism that ensures that bad projects are terminated because bad signals are not revealed to investors or depositors, creating unduly optimistic expectations. Hence, loss-making projects can be hidden for a long time by 'overborrowing'. These problems only become apparent when an exogenous shock, even a very mild one, hits the economy.

While there has been a healthy analytical debate of the Asian financial crisis, accompanied by the development of new theoretical models, there has been very little empirical testing of the various hypotheses that have been put forward in the specific context of the Asian crisis. This paper makes a step in this direction by providing new empirical evidence from South Korea that sheds light on the theoretical explanations outlined above. Specifically, we provide an empirical analysis of the Korean credit market, which shows that, with few exceptions, it was characterised by excessive credit creation since the late 1960s. We interpret our estimates of excess credit as measures of 'unproductive credit', ultimately translated into non-performing loans. Our empirical findings are broadly consistent with the 'overlending' and 'overinvestment' hypothesis. However, we also argue that the presence of 'unproductive' credit by itself need not lead to a financial crisis, so that in order to provide an explanation for the crisis one needs to examine other developments during the 1990s. Specifically, we argue that 'unproductive' credit became a major source of fragility only after the liberalisation of short-term capital flows in the 1990s, which eroded the ability of the Korean central bank to act as an effective lender of last resort, thereby creating fertile ground for financial panic.

We also provide an empirical analysis of total factor productivity (TFP) growth that warns against an over-simplification of our finding concerning unproductive credit. Specifically, we show that in spite of the presence of unproductive credit, the banking system's contribution to TFP was significantly positive during the last three decades,

[2] In Corsetti, Pesenti and Roubini (1999), the threshold is expressed as a fraction of implicit government liabilities which mainly arise due to excessive foreign borrowing by the private sector and overinvestment in low productivity projects. It is interesting to note that these implicit government liabilities can coexist with a low public debt and budget deficit.

although TFP would have been greater had the proportion of 'unproductive' credit to total credit been smaller.

The rest of the paper is organised as follows. Section 2 presents the empirical analysis of the Korean credit market while Section 3 focuses on the impact of financial development and excess credit on average productivity of capital. Finally, section 4 summarises and concludes.

2. 'Unproductive Credit'

This section provides an empirical analysis of the South Korean credit market that reveals the presence of persistent excessive credit creation by the banking system. Our empirical analysis is novel in at least two respects. Firstly, it takes into account the institutional characteristics of the South Korean credit market, including the direct effects of financial restraints that were prevalent until the late 1980s. Secondly, it utilises modern time-series methods that allow us to construct a measure of short-run disequilibrium, which reflects excess supply or demand.

We begin with a discussion of econometric methodology, followed by a brief outline of the institutional characteristics of the South Korean credit market. We then specify our credit market model, discuss our estimation method and data and present our results. The concluding part of this section provides an analytical discussion of the implications of excess credit, exploring its interactions with other financial vulnerabilities, thereby offering a plausible explanation of the crisis.

Methodological Issues

In evaluating whether a credit market is characterised by credit-rationing or excess supply, previous empirical studies (e.g. Laffont and Garcia, 1977; Pazarbasioglu, 1996) have used a disequilibrium model of supply and demand due to Maddala and Nelson (1974). This method of estimation assumes that in some markets, prices are not perfectly flexible and hence disequilibrium could occur. In the absence of any information concerning the price-adjustment process, the probability with which each observation belongs to the demand or supply function is determined by assuming that the short side of the market is never rationed. Maddala and Nelson (1974) derive the appropriate maximum likelihood method for this class of models.

By stipulating that the long side of the market is the one that is rationed, the traditional disequilibrium approach, while allowing for notional excess supply, rules out the possibility of an effective excess supply of credit. That is to say, in this framework an excess supply of credit can only represent the case in which banks are willing to supply more credit than firms are willing to accept, so that an excess supply of credit can never

be realised. In practice it is possible that firms take on more credit than would be predicted by the usual long-run determinants of the demand for credit – which typically include the cost of credit and an indicator of real economic activity. The case of an effective oversupply of credit may reflect the presence of 'unproductive credit', i.e. credit that is not used to finance new productive activities. The latter may be the result of loss-making projects that are continually refinanced by banks. Banks have many reasons why they may wish to refinance unprofitable projects. These include their desire to prevent bankruptcies, the hope that the companies concerned may be able to cross-subsidise loss making projects from more profitable ones or – ultimately – be bailed out by the government. Thus, 'unproductive credit', or an oversupply of credit, corresponds closely to the notion of overinvestment, reflecting soft budget constraints and/or moral hazard. The reason why companies, in turn, may in the short run willingly accept more credit than is predicted by their long run demand function is that it keeps them afloat, allowing them time to restructure or engage in profitable activities. In a rapidly growing economy like South Korea this situation was quite common.

This analysis suggests that the effective or short-run stock of credit may well exceed the long-run desired demand for credit, as a result of 'unproductive credit'. It is, therefore, vital to allow for the possibility that a short-run observation may belong to neither the long run demand nor the long run supply function. In spite of the short run deviations from long-run equilibrium, it is nevertheless plausible to expect to see some adjustment towards long-run market equilibrium for both demand and supply functions. This assumption is consistent with both theoretical and empirical work. For instance, despite the presence of information asymmetry, Laffont and Garcia (1977) find that the real interest rate has the tendency to adjust upwards when there is excess demand for credit. On the other hand, when there is an excess supply of credit, there is no reason why the interest rate should not fall to equilibrate the market (Greenwood, Levinson and Stiglitz, 1993).

Modern time-series econometric methods, such as cointegration and error-correction, allow long-run behaviour to be driven by economic theory and short-run dynamics to be determined flexibly by the data[3]. Thus, we use cointegration analysis to estimate the underlying long-run equilibrium relationship between the stock of credit and its determinants. This, in turn, allows us to construct a measure of short-run disequilibrium, which may reflect either 'unproductive credit' – discussed above – or credit rationing. The latter case – i.e. when the actual stock of credit is lower than the long-run equilibrium stock of credit – corresponds to the traditional approach to

[3] See for example Hendry (1995) or the papers in the Engle and Granger (1991) edited volume.

'financial repression' of McKinnon (1973) and Shaw (1973)[4]. This approach suggests that interest rate restrictions and other 'repressive' policies, by depressing real interest rates, lead to a shortage of credit.

To summarise, our estimation method differs from the traditional disequilibrium approach outlined above in the following four important respects.

1. It assumes that in the long run, the interest rate adjusts to equilibrate the credit market while allowing for departures from long-run equilibrium to occur in the short run.

2. Our approach does not impose a priori restrictions on the speed of adjustment, which admits the possibility that the credit market may take a very long time to clear. Thus, the assumption that in the long-run market equilibrium prevails is not a restrictive one, since the long run is determined by the data.

3. Our method of identifying periods of excess supply or demand for credit does not depend on the somehow arbitrary method of estimating a set of probabilities, which are then used to locate an observation on the long run demand or supply function. Instead, our method of identifying excess supply or demand consists of measuring the departure of actual credit from its predicted long-run equilibrium value, utilising standard techniques in applied time-series econometrics.

4. Our method allows the possibility that the actual stock of credit may exceed the long run demand for credit, representing the presence of 'unproductive credit', which the traditional disequilibrium approach does not admit.

Institutional Characteristics

Since the early 1960s, one of the most important institutional characteristics of the South Korean credit market has been the direct intervention of the state in the allocation and pricing of credit. This was mainly achieved through controls on lending and deposit interest rates. These controls were in place until the late 1970s when the Korean government embarked on a programme of financial liberalisation. The centrepiece of various attempts at financial liberalisation in Korea and elsewhere has been interest rate deregulation (Demirgüç-Kunt and Detragiache, 1998). In 1979, the Monetary Board abolished the maximum interest rate on bank loans. However, given Korean banks' inexperience in setting interest rates, the Korean Bankers' Association linked the lending interest rate to the Bank of Korea's rediscount rate, limiting seriously the ability of commercial banks to alter interest rates on loans. In 1984, banks were allowed to charge different rates according to borrowers' creditworthiness, but within a very narrow band. It is not until 1988 that banks began to enjoy freedom over

[4] See Fry (1995) for an overview of this literature.

interest rate determination when controls on lending rates for both banks and non-bank financial intermediaries were relaxed. The liberalisation process continued in the 1990s. In 1995, the Bank of Korea liberalised interest rates on policy loans and in 1996 lifted the restriction on the size of the premium a bank could charge over its prime lending rate.

The relaxation of ceilings on deposit rates was a very gradual process. In 1979, the Monetary Board abolished the maximum interest rate ceiling on personal checking deposits, but maintained controls on all other forms of deposits. It is only as recently as 1988 that interest rate controls on certain time and saving deposits were liberalised. Specifically, the Bank of Korea lifted interest rate controls on time deposits of maturity greater than 2 years at banks, postal savings and credit unions, and on time and savings deposits of maturity greater than 1 year at mutual savings and finance companies. In 1991, the scope of initial liberalisation was extended to cover rates on long term deposits with a maturity of 3 years offered by banks, mutual credit facilities, and credit unions. During the period 1993–1994, the interest rate on long term deposits with a maturity of at least two years were completely liberalised. It is only as recent as in 1995 that the Bank of Korea removed restrictions on the remaining regulated interest rates on bank and non-bank time deposits with a maturity of less than six months.

Model specification

We specify a model for the long-run demand for and supply of bank credit, which takes into account the institutional characteristics outlined above.

A. The long-run supply of credit equation

The real supply of loans in the long run is expected to depend upon the real lending interest rate (r), the current output (y) and financial restraints. The first two variables are widely used in empirical studies to capture respectively the profitability of banks' lending activities and the expectations about the state of the economy (Laffont and Garcia, 1977; Pazarbasioglu, 1996). The influence of financial restraints on the supply of credit, on the other hand, has not been addressed in the empirical literature on credit markets despite their presence in many developing and developed countries (Pazarbasioglu, 1996; Ghosh and Ghosh, 1999).

The impact of interest rate controls on the real supply of credit is not straightforward. In principle, lending rate controls, by limiting banks' profitability, should affect adversely the real supply of credit to the private sector. However, as noted by Caprio (1994), in the presence of higher interest rates, which usually follow financial liberalisation, banks may choose to hold larger amounts of riskless assets and hence supply fewer loans to the private sector. Hence, the impact of the relaxation of lending rate controls on the supply of credit is ambiguous. The same conclusion holds for the

impact of deposit rate controls on the supply of real credit, even though the reasoning is different. On the one hand, these controls limit the cost of funds for banks and hence increase the willingness of banks to supply increased amounts of credit. On the other hand, however, deposit rate controls limit the supply of funds to the banking system which, unless counteracted by other means, such as increased branching or marketing, are likely to reduce the ability of banks to supply increased amounts of credit.

In addition to interest rate restraints, financial restraints typically include required reserve requirements on bank deposits (demand and/or time and savings deposits). Usually, the definition of reserves includes short-term government paper and/or central bank deposits, which typically yield a lower rate of return than bank loans. Hence, increases in reserve requirements raise the average cost of loanable funds and are, therefore, expected to result in an inward shift of the supply of credit to the private sector.

Thus, we use the following specification for the long-run supply of credit:

$$C^s = b_0 + b_1 y + b_2 r + b_3 IRR + b_4 RR + u_t \qquad (1)$$

Where IRR is the interest rate restraints and RR is the required reserve ratio.

B. The long-run demand for credit equation

We specify a simple long-run demand for credit equation where the real demand for credit depends positively on the level of real economic activity, approximated by real GDP (y) and negatively on the cost of credit, measured by the real lending rate (r). Thus, we use the following specification for the long-run demand for credit:

$$C^d = a_0 + a_1 y + a_2 r + v_t \qquad (2)$$

C. Reduced Form

We assume that in the long-run, the real interest rate is flexible enough to equate the real supply and demand for credit i.e. the exchanged quantity of credit is such that:

$$Q^c = C^d = C^s \qquad (3)$$

We next solve for the reduced form equation by substituting the value of r from equation (2) in (1) to obtain the following:

$$C = g_0 + g_1 y + g_2 IRR + g_3 RR + w_t \qquad (4)$$

Where $g_0 = (a_2 b_0 - a_0 b_2 / a_2 - b_2)$

$g_1 = (a_2 b_1 - a_1 b_2 / a_2 - b_2)$; $g_1 > 0$

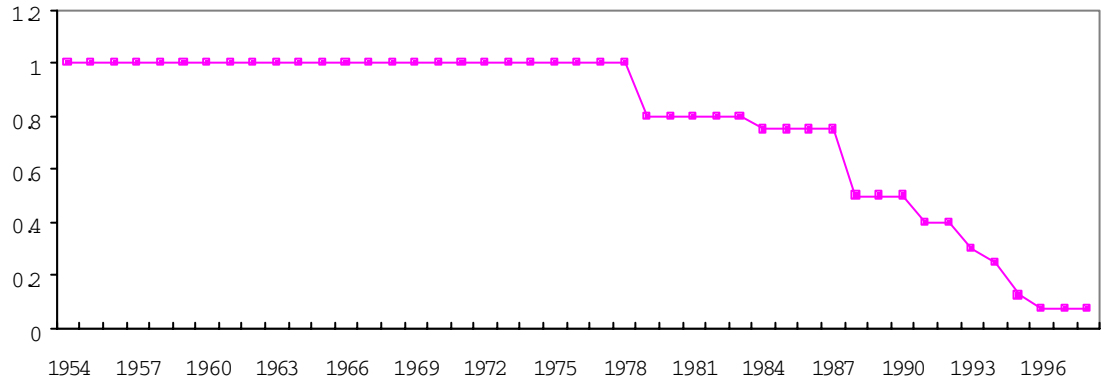
$g_2 = (a_2 b_3 / a_2 - b_2)$ $g_2 > 0$ or $g_2 < 0$

$g_3 = (a_2 b_4 / a_2 - b_2)$ $g_3 < 0$

Data

Two variables are used to measure the dependent variable: real broad claims and real narrow claims on the private sector. Real broad credit (D_B) is measured by (the logarithm of) claims on private sector by deposit money banks, trust accounts of commercial banks, development banks, and non-bank financial institutions, deflated by the GDP deflator. Real narrow credit (D_N) is (the logarithm of) a narrower measure that includes claims on private sector of deposit money banks only. The data source for these variables, as well as real GDP and the GDP deflator, is International Financial Statistics (CD ROM, 1998:6).

Figure 1 – Summary Measure of Interest Rate Restraints

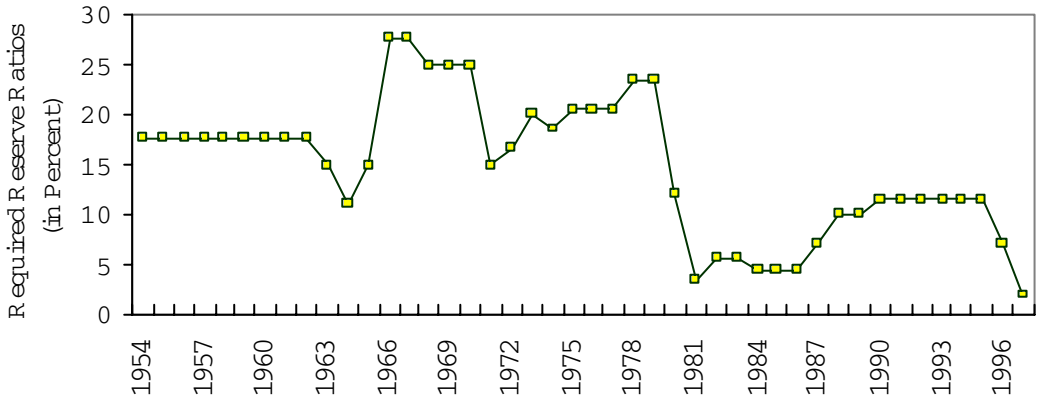


The lending-rate and deposit-rate control variables are constructed from data collected from Bank of Korea, Annual Reports (various issues). These variables are simple arithmetic averages of dummies that take the value of 1 in periods when a specified interest rate is controlled and 0 otherwise. Strong positive correlation between the lending-rate and deposit-rate control variables allows us to average them out into a single summary measure of interest rate restraints (IRR). This measure is plotted in figure 1. Its movements reflect the changes in the underlying policy variable reasonably well. The relaxation of lending controls in 1979 is reflected in a sharp drop in the measure for that year. The measure then exhibits relative stability until 1988, when it drops sharply following the liberalisation of interest rates on certain types of time and

savings deposits. Further drops are observed in the early 1990s reflecting further deregulation in deposit rates and lending rates on policy loans.

Data on reserve requirements on (i) demand and (ii) time and saving deposits were collected from Bank of Korea, Annual Reports (various issues). Because of the very high correlation between the two variables, we use their arithmetic average as a summary measure of reserve requirements (RR). This measure, illustrated in Figure 2, registers an upward jump during 1966-67, which coincides with the first wave of reforms that saw large increases in interest rates and reserve requirements, resulting in increased state control over the banking system (Harris, 1988). RR exhibits a decline during 1968-1971 and fluctuates widely in the 1970s. In the early 1980s, the index shows a sharp decline, which coincides with the relaxation of lending rate controls while the 1987-1989 period registered considerable increases in reserve requirements. In the 1990s, RR exhibits relative stability to decline significantly in 1997 when required reserve requirements on all types of deposits were set at 2% .

Figure 2 - Summary Measure of Reserve Requirements



Estimation

All variables were initially subjected to unit root tests, which suggested that both measures of the stock of credit, as well as real GDP, the interest rate restraints, and reserve requirements are non-stationary. Since these variables contain unit roots, we use a cointegration estimator to estimate the reduced form relationship between them given by equation (4). Specifically, we apply the dynamic ordinary least squares (DOLS) estimator (Saikkonen, 1991; Stock and Watson, 1993). This estimator is asymptotically equivalent to Johansen's (1988) maximum-likelihood estimator in the case where variables are I(1) and there is a single cointegrating vector. Moreover, it has been shown to perform well in finite samples relative to other asymptotically efficient

estimators (Stock and Watson, 1993). In these circumstances it is known that the Engle–Granger (1987) estimator may exhibit substantial bias (Banerjee et al, 1986; Stock and Watson, 1993). DOLS has a further advantage over the Engle-Granger estimator. While the latter suffers from a non-standard asymptotic distribution (Park and Phillips, 1988), the former allows valid and efficient inferences on the parameters of the cointegrating vector. We first apply DOLS to the reduced–form equation (equation 4) and obtain estimates of the cointegrating vector for the credit market. We next compute the predicted long–run equilibrium values and compare them with the corresponding actual stock of real credit, which allows us to construct our measure of disequilibrium credit.

Empirical Results

Table 1 reports the results of estimating equation (4) using two different definitions of the dependent variable. In Model A the latter is measured by (the logarithm of) real broad claims while in Model B it is measured by the logarithm of real narrow claims. The interest rate–restraints index enters with a positive sign, indicating that relaxation of interest rate controls results in a decline of the equilibrium stock of real credit to the private sector. The rest of the explanatory variables enter with the expected signs and are statistically significant. The estimated coefficient of real GDP has the expected positive sign, takes a plausible value and is statistically significant while the reserve requirement index enters with the expected negative sign and is also statistically significant at the 5% level. The equation performs well as reflected in high R^2 and passes various diagnostic tests. Finally, according to the Dickey-Fuller and Augmented Dickey-Fuller statistics, the hypothesis of a unit root in the residuals is rejected at the 1% level. There is, therefore, little doubt that Model A represents a cointegrating relationship.

The results from Model B are similar to those obtained above with two exceptions. First, the reserve requirement index enters with a positive sign, but is not significant at conventional levels.[5] Second, the coefficient on interest rate restraints is considerably bigger than that of model A. This is not surprising since these restraints were mainly imposed on deposit money banks and hence are likely to have a bigger impact on these banks' lending activity. Model B also performs well and passes various diagnostic tests. Furthermore, the hypothesis of a unit root is rejected at the 1% level indicating that Model B forms a cointegrating vector.

[5] However, it is interesting to note that the first lag and the first lead of the first difference of this index (not reported in the table) enter with the expected negative sign and are significant at the 1% level.

Table 1 – Cointegrating Vector for the Credit Market

(Sample period: 1954–1997)

Regressors	Model A D_B	Model B D_N
Intercept	–36.277*	–47.177*
	(1.686)	(2.997)
LY_t	2.098*	2.387*
	(0.051)	(0.092)
IRR_t	0.615*	1.857*
	(0.148)	(0.215)
RR_t	–0.006**	0.001
	(0.003)	(0.005)
Diagnostic tests		
Adj-R^2	0.995	0.986
J-B	0.105 [0.948]	4.435 [0.108]
Q (10,0)	8.054 [0.623]	15.74 [0.107]
Cointegration test		
DF	–4.650*	–4.014*
ADF(1)	–5.246*	–4.711*
ADF(2)	–4.137*	–3.793*

Notes:

(1) D_B denotes (the logarithm of) real broad claims on private sector by deposit money banks, development banks, non-bank financial institutions and trust accounts of commercial banks. D_N is a narrower measure which excludes development banks and non-bank financial intermediaries and trust accounts. The GDP deflator deflates both these variables.

(2) LY denotes the logarithm of real GDP, IRR is the index of interest rate restraints; and RR is the index of reserve requirements. The equation also includes a dummy variable for the 1973 oil crisis. Figures in parentheses are the adjusted-standard errors (See Hamilton, 1994).

(3) The method of estimation is DOLS (Stock and Watson, 1993). Given the small number of observations, to avoid over-parameterization we only retain significant lags and leads (Inder 1995).

(4) J-B is Jaques Berra's test for normality; Q is Ljung and Box test for autocorrelation. Figures in brackets are the p-values.

* Significant at the 1% level; ** Significant at the 5% level.

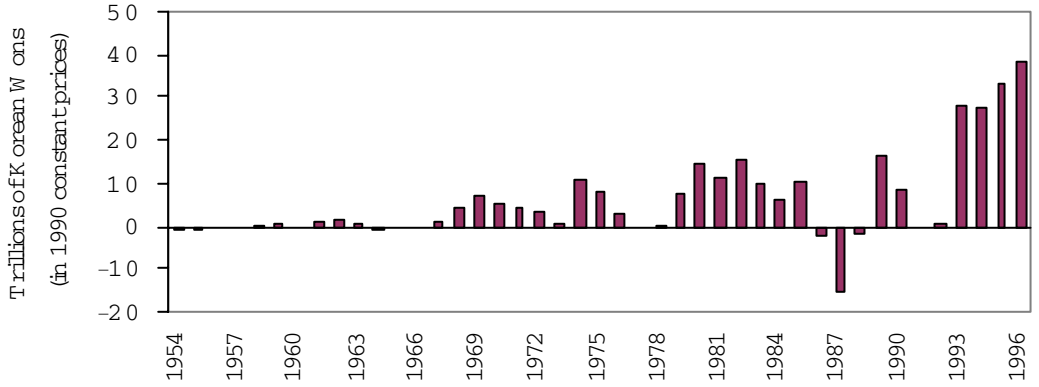
Table 2 contains our measure of credit market disequilibrium, based on Model A. This measure is obtained by subtracting the predicted long-run equilibrium value of credit from the actual stock of real credit and dividing this difference by real total claims. Hence, it is the proportion of total credit that represents excess supply or demand. Table 2 also includes the Bank of Korea's estimates of non-performing loans as a percentage of total credit, for comparison purposes. We also plot our estimates of excess demand and excess supply of credit (in trillions of Korean wons), again based on model A.

Table 2 – Estimates of Oversupply of Credit

Period	EXC_B[1] (% of real broad claims)	Non-Performing Loans[2] (% of total credit)[3]
1960–1969	13.45	1.5[4]
1970–1979	13.17	1.7
1980–1989	7.82	7.8
1990	3.33	7.5
1991	0.00	6.6
1992	0.16	6.7
1993	7.78	7.0
1994	6.75	5.6
1995	7.20	5.2
1996	7.30	3.9

Notes:
(1) EXC_B is excess supply of credit estimated using Model A in Table 1.
(2) Non-performing credit of the 26 commercial banks (16 nationwide banks and 10 regional banks). Prior to 1990, figures refer only to nationwide commercial banks. Sources: Bank of Korea; Park and Kim, 1994.
(3) Total credit includes guarantees and loans from trust accounts.
(4) Includes the period 1962–1969 only.

Figure 3 – Excess Demand and Supply of Credit



What emerges from Figure 3 is that the South Korean credit market has been characterised by:

- cycles of very mild excess demand and supply until the mid-1960s.
- increasingly large cycles of excess credit since the mid-1960s, with one notable exception in the mid-1980s.

However, in relative terms the picture is somewhat different, as shown in Table 2. The average proportion of excess credit in the 1970s was approximately 13%, declining to 8% in the 1980s and to 4.6% in the 1990s. Notably, however, it was around 7.2% in the 1993–96 period, which preceded the crisis.

A comparison with the Bank of Korea's estimates of non-performing loans reveals that while our 1960–1970 estimates diverge from the Bank of Korea's figures, the 1980s and 1990s estimates are reasonably close. Interestingly, our estimates of unproductive credit in 1993 onwards are greater than the Bank of Korea's figures. This may be partly because the Bank of Korea figures include credit by commercial banks only, while our definition of credit is broader. This may explain why our estimates for the most recent years paint a worse picture than the Bank of Korea's figures, as non-bank financial institutions suffered more from bad loans than commercial banks.

Interestingly, table 2 shows that the proportion of excess credit was equally acute in the 1980s, according to both our estimates and those of the Bank of Korea, and more acute, according to our own estimates in the 1970s. While we may not wish to place much emphasis on the 1970s figures, especially given their divergence with those of the Bank of Korea, the 1980s picture clearly remains. However, if we consider the excess supply of credit in absolute terms, it is very clear from figure 3 that the volume of unproductive credit increased sharply during the 1993–1996 period.

Analysis of Empirical Findings: The Crisis

The persistence of excess credit for a very long time is consistent with the notion of 'overinvestment', which suggests the existence of moral hazard and/or soft budget constraints. This excess credit, which we refer to as 'unproductive', may have been used to refinance unprofitable projects and cash shortfalls and ultimately translates into non-performing loans (see also Corsetti et al, 1999). This, however, does not necessarily prove that 'unproductive credit' was a cause of the financial crisis. It does, nevertheless, provide some clues, especially if it is examined in conjunction with earlier developments. A particularly important development in the 1979–1981 period was the way in which bad debts were dealt with. During that period, banks accumulated large amounts of non-performing debt which the Bank of Korea covered by issuing subsidised credit, essentially by printing domestic money. This averted a serious banking crisis, although at a cost of high inflation (Choi, 1993; Nam, 1994). In the 1980s, however, South Korea was not integrated in international financial markets, which allowed this type of 'solution' to work. In contrast, by the early 1990s, this was no longer possible. Financial liberalisation, which removed many government restrictions on foreign capital inflows, encouraged commercial and merchants banks to borrow heavily from foreign sources on short maturities. Ineffective prudential

supervision, insufficient regulations, and regulatory distortions which favoured short-maturities intensified the wave of short-term foreign borrowing (Chang, Park and Yoo, 1998). These and other factors[6] contributed heavily to the accumulation of short-term foreign liabilities in the banking system, while international reserves which could cover for them were very low. This situation increased banks' vulnerability to changes in the sentiments of foreign lenders. Contagion effects from the rest of the region and a series of corporate bankruptcies acted as a 'wake-up call' for foreign investors to reassess the fundamentals of the Korean economy, including the banking system (Goldstein, 1998). The re-assessment exposed serious weaknesses in the corporate and banking sector to which foreign investors reacted by withdrawing their investments from the Korean economy, in many cases by refusing to renew short-term loans. The large stock of short-term foreign liabilities relative to foreign reserves, however, meant the central bank could not guarantee the foreign debt neither could it act as a provider of sufficient amounts of dollar liquidity to avert a run by foreign lenders. In essence, the Bank of Korea's role as a lender of last resort was eroded by this imbalance. Thus, the Korean banking system became prone to "self-fulfilling" bank runs by foreign lenders.[7]

3. Productivity, Growth and Credit

This section carries out an empirical analysis of the sources of growth in South Korea, building on recent work on the productivity of capital in East Asia by Demetriades, Devereux and Luintel (1998). This empirical analysis enables us to test whether excess credit can be considered as 'unproductive'. Furthermore, it enables us to assess the extent to which 'unproductive' credit contributed to the slowdown of TFP. Our empirical approach involves a number of empirical novelties. Importantly, instead of measuring TFP as a residual, we estimate it directly by modelling its sources. To this end we assume that TFP can be ascribed to financial development and financial restraints. Another empirical novelty is that we utilise the DOLS estimator, which allows us to disentangle the long-run relationship between inputs and sources of TFP growth from short-run dynamics.

Model Specification

The development of the banking system is expected, in principle, to have a positive effect on productivity, because its screening and monitoring functions are likely to

[6] Other factors include the pegged exchange rate system which generated a false sense of security, nullifying expectations of devaluation and tight monetary policy which kept domestic interest rates above world interest rates, encouraging banks to realy heavily on cheaper foreign credit (Demetriades and Fattouh, 1999).

[7] Despite the fact that these short-term loans could have been paid off in the future, foreign lenders were not willing to renew them. This panic situation on the lenders' behalf may have been responsible for placing the Korean economy on a 'crisis' equilibrium (see for instance, Radelet and Sachs, 1998).

result in better investments (Pagano, 1993). Other variables that could influence the ability of the banking system to affect TFP growth are interest rate restraints and the level of the real interest rate. We expect the real interest rate to also have a positive effect on TFP, since it is likely to act as a screening device for investment projects (Fry, 1995). As to interest rate restraints, their impact on average productivity of capital is ambiguous. It may be argued that such restraints impede the process of financial deepening, reducing both the volume and productivity of investment (Fry, 1995). According to this view, financial liberalisation policies have positive effects on the efficiency of investment. On the other hand, interest rate restraints may influence banking system's attitude towards risk-taking; a restrained banking system would be expected to take fewer risks, financing safer investments and hence increasing the efficiency of investment (Hellman, Murdock, and Stiglitz, 1996 a,b).

We therefore estimate the following equation, in which the capital stock is lagged once in order to avoid possible simultaneity:

$$\text{Log}(Y_t/K_t) = b_0 + b_1 \log K_{t-1} + b_3 \log L_t + b_4 \log FD_t + b_5 R_t + b_6 IRR_t + \varepsilon_t \qquad (5)$$

Where the dependent variable is the logarithm of the ratio of output (Y) to the capital stock (K). L represents employment, FD is an indicator of banking sector development, R is the real interest rate and IRR are interest rate restraints.

Equation (5) has a useful interpretation in that it explains the average productivity of capital, which is the focus of much of the literature on financial development and growth (Arestis and Demetriades, 1997). This is also why the financial sector variables have a natural interpretation as the determinants of the productivity of the capital stock. It is, after all, the financial sector that largely determines what kinds of investment projects are financed. We also control for the influence of the capital and labour inputs; note that the coefficient of the capital stock is expected to be negative, assuming diminishing returns to capital.

Data

We measure the average productivity of capital by the ratio of the flow of current output to the capital stock. Data on the capital stock for the period 1963–1990 were obtained from the World Bank Database compiled by Nehru et al (1993). Capital stock figures from 1991 to 1997 were constructed following the perpetual inventory method assuming a depreciation rate of 4% and uprating the price of capital goods in line with the GDP deflator. Investment and GDP data were obtained from International Financial Statistics (CD-ROM, 1998:6). Data on employment were obtained from the UN, Statistical yearbook for Asia and the Pacific (various issues). Real interest rates

were measured by the general lending rate minus the current inflation rate. The data on interest rates were collected from the Bank of Korea, Annual Reports (various issues). The interest rate restraint index is defined as in the previous section and is constructed using data collected from Bank of Korea, Annual Reports (various issues). Finally, financial development is measured by the ratio of nominal broad claims on private sector to nominal GDP. The data for these variables were obtained from International Financial Statistics (CD-ROM, 1998:6).

Empirical Results

Table 3 reports the estimated long-run cointegrating vector for the average productivity of capital. Three different specifications are reported, depending whether we include a measure of unproductive credit or not. Model A includes only a measure of financial development while Model B includes also a measure of 'unproductive' credit, measured by the ratio of excess supply of credit to total broad claims. Model C excludes the real interest rate, as this was found to be insignificant in the two previous specifications.

All the variables are significant except for the real interest rate. The implied elasticity of the capital stock ranges from 0.42 to 0.47, which is a plausible range. The elasticity of labour ranges from 0.53 to 0.67, which is also in a reasonable range. In all three models, the financial development indicator enters significantly with the expected positive sign. Interestingly, the ratio of excess credit to broad claims enters significantly with a negative sign. This finding strengthens the view that the estimated excess credit could be interpreted as 'unproductive'. Finally, interest rate controls enter significantly with a negative sign in both models B and C. This result indicates that the presence of interest rate restraints may have allowed the financing of unproductive projects, reducing the efficiency of investment and hence decreasing the average productivity of capital. All three models perform well as reflected in the high R^2; they also pass various diagnostic tests, except for model A where the null hypothesis of normality is rejected. Finally, according to the Augmented Dickey Fuller statistics, the hypothesis of a unit root is rejected at the 5 % level, indicating that these estimated models form cointegrating vectors.

Sources of TFP growth

Table 4 decomposes output growth into its various sources, using the estimated coefficients of Model C (Table 3). In line with other studies on the sources of growth in East Asia (Young, 1993; Bosworth et al, 1995; IMF, 1998), we find that the dominant factor contributing to growth was capital accumulation. On average, over the period 1966-96, the contribution of the capital stock to economic growth was 5.29 percentage points, while labour contributed 2.05 per cent. A significant contribution

was made by the financial system, in that financial depth was the main factor behind TFP growth, contributing on average 1.18 percentage points per annum. On the other hand, unproductive' credit was responsible for a reduction in TFP by 0.05 per cent per annum, while interest rate liberalisation made a positive contribution of 0.33 per cent. Overall, we find that TFP contributed 1.47% to GDP growth during 1996–94, which is very close to Young's (1993) estimate of 1.7%, and higher than the 0.7 estimate of Boswarth et al (1995).

Table 3 – Cointegrating Vector for Average Productivity of Capital[1]

(Sample period: 1963–1996)

Regressors	Model A	Model B	Model C
Intercept	7.988*	7.920*	–7.306*
	(3.171)	(1.559)	(1.327)
LK_{t-1}	–0.530*	–0.557*	–0.582*
	(0.109)	(0.054)	(0.043)
LL_t	0.532*	0.586*	0.673*
	(0.392)	(0.198)	(0.161)
LFD_t	0.148*	0.175*	0.172*
	(0.056)	(0.019)	(0.019)
R_t	0.001	0.001	____
	(0.002)	(0.001)	
IRR_t	–0.090*	–0.123*	–0.129*
	(0.066)	(0.023)	(0.022)
$EXCB_t$	____	–0.188*	–0.196*
		(0.036)	(0.035)
Diagnostic Tests			
Adj-R^2	0.990	0.997	0.997
J-B	9.719 [0.007]	2.443 [0.294]	1.425 [0.490]
Q (7,10)	3.780 [0.876]	8.210 [0.314]	8.832 [0.264]
Cointegration Test			
DF	–2.809	–2.892	–2.913
ADF(1)	–3.462**	–3.565**	–3.602**
ADF(2)	–3.594**	–3.800**	–3.806**

Notes:

(1) The dependent variable is the logarithm of the ratio of current real GDP to real capital stock lagged once (Y_t/K_{t-1}). The method of estimation is DOLS. To avoid over-parameterization we only retain significant lags and leads (Inder 1995). Figures in parentheses are adjusted-standard errors.

(2) LK denotes the logarithm of the real capital stock, LL is the logarithm of employment, LFD is the logarithm of the ratio of nominal broad claims on private sector to nominal GDP; R is the real interest rate; IRR is the interest rate restraints; and EXC^B is the ratio of real excess supply of credit (estimated using the cointegrating vector of Model A-Table 1) to real broad credit with negative values replaced by zeros.

*Significant at the 1% level; ** Significant at the 5% level.

Table 4 – Sources of Economic Growth: Estimated Contribution of Capital, Labour and Total Factor Productivity[1] (In Percent)

		Inputs			Total Factor Productivity				
Period	RG	K	L	FD	IRR	EXC	Total	DD	RES
1971–1975	7.81	5.26	2.61	0.00	0.00	–0.03	–0.03	0.73	–0.77
1976–1980	6.81	6.06	1.96	1.01	0.52	0.03	1.56	–2.23	–0.55
1981–1985	7.77	4.07	1.21	0.92	0.13	0.06	1.11	1.07	–0.23
1986–1990	9.55	4.60	2.54	0.93	0.65	0.19	1.77	0.02	0.60
1991–1995	7.18	4.76	1.61	0.70	0.97	–0.15	1.52	——[2]	——[2]
1966–1994	8.64	5.29	2.05	1.18	0.33	–0.04	1.47	–0.23	0.04

Notes:

(1) Based on Model C, Table 3.

(2) Due to lags and leads, error terms and dynamics can't be averaged using out the entire period.

(3) RG denotes the real growth rate, K is capital stock, L is labour, FD is financial depth, IRR is interest rate restraints; EXC is the excess supply of credit, DD denotes the dynamic terms and RES is the residual.

The evidence on the most recent decade shows that the slowdown in GDP growth from 9.6% during 1986–90 to 7.2% during 1991–95, largely reflects a reduction in the growth of employment from 2.54 to 1.61 and a fall in TFP from 1.77% to 1.52%. The fall in TFP can be attributed almost entirely to a slowdown in financial development from 0.93% to 0.70%. Furthermore, 'unproductive' credit seems to have contributed to the slowdown of TFP during the first half of the 1990s.

The results of this section warn against an over-simplification of our finding concerning unproductive credit. Specifically, in spite of the presence of unproductive credit, the banking system's contribution to TFP was significantly positive during the last three decades, although TFP may have been somewhat higher had the proportion of 'unproductive' credit to total credit been smaller. This is, of course, easier said than done, especially for a system that was financing exceptionally high rates of capital accumulation in a rapidly growing economy. It may, therefore, be argued that at least to some extent 'unproductive credit' may have been an unavoidable side effect of the policies that supported rapid rates of capital accumulation and growth of the past.

4. Concluding Remarks

The empirical analysis presented in this paper reveals an underlying structural weakness in the Korean financial system, in the form of persistent excess credit. Our empirical analysis of TFP growth confirms that the estimated excess credit could be

interpreted as 'unproductive', indicating that a sizeable proportion of total credit was used to refinance unprofitable projects and cash shortfalls. Our findings are, therefore, consistent with the hypotheses of 'overlending' and 'overinvestment', which may reflect soft budget constraints and/or moral hazard (Huang and Xu, 1999; Corsetti et al, 1999).

We have argued, however, that unproductive credit may well have been an unavoidable side effect of policies that supported rapid rates of capital accumulation and growth and that it was not by itself responsible for the financial crisis. In the 1980s the Korean government was able to avert a banking crisis in spite of the presence of a large volume of non-performing debt by inflating its way out of the problem – essentially by printing money. This was no longer possible by the mid-1990s because the bulk of short-term liabilities in the banking system were in foreign currency while international reserves that could provide cover for them were very low. Combined with weaknesses in the management of financial risks and lax prudential regulation, this provided fertile ground for financial panic[8]. When the crisis erupted, the collapse of the exchange rate and the higher interest rates used to defend the currency ensured that its magnitude was out of proportion to any underlying structural weaknesses.

Finally, our empirical analysis of the Korean financial crisis has an interesting implication for the earlier literature on financial repression. 'Financial repression' in Korea resulted in oversupply of credit and overinvestment, instead of credit rationing and underinvestment predicted by that literature.

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[8] For a detailed analysis of the role of financial liberalisation in the Asian crisis see Demetriades (1999).

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