THE IMPACT OF BANKING CAPITAL CONCENTRATION ON EFFICIENCY OF BANKING INTERMEDIATION: CASE OF UKRAINE

by

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Abstract

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The paper investigates impact of banking capital concentration on intermediation efficiency of Ukrainian banking sector. The study is conducted on both micro- and macrolevels in order to have a composite and comprehensive view of the problem. On the macrolevel intermediation efficiency is measured by interest spread, the difference between average rates on loans and deposits, and by interest margin on the microlevel.

Theoretically relation between concentration and intermediation efficiency is ambiguous: on the one hand, in more concentrated markets each bank on average has stronger market power, being able to set higher margins. On the other hand, economy of scale improves efficiency due to decreasing marginal costs. We test the impact of concentration on intermediation efficiency empirically.

We found that large banks tend to set lower margin and have lower fraction of overhead costs in total costs, operating more efficiently. On the other hand, macro study reveals positive relation between concentration and spread, however the result is not reliable taking into account small number of observations and very low fraction of spread explained by dynamic of concentration.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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Chapter 1

INTRODUCTION

Rapid development of financial institutions among middle- and low-income countries and increasing share of financial sector in high-income countries suggest that financial development plays an increasingly important role in the economy. Financial sector does not yield any physical product, however its contribution to growth and economic importance is not inferior to the ones of real sector: intermediation activity of financial intitutions helpsreal sector operate efficiently. Acting as financial intermediariers, banks provide benefits to those who accumulate savings and satisfy the demand for liquid assets from economic agents, they also provide transaction services (facilitate money transactions), information services and consulting, playing the crucial role in economic growth.

Caner and Kontorovich (2003) distinguish the following types of intermediation:

- **Financial intermediation, that is accumulation of saving and then providing it to the most profitable producers;**
- Security market intermediation, which is a linkage between flows of savings and investments, including financial asset transactions (securities).

Like every economic activity, banking intermediation has its costs and brings some benefits. It is a very important question what the eficiency of such intermediation is. Banks are competing at the market of financial services, and competition is regarded as driving force of efficiency improvement. Economic theory suggests that perfect competition results in Pareto optimality. Though perfect competition never occurs in reality, at least for banking sector, and we always face up with some degree of monopolization. It seems that evem imperfect monopolization leads to efficiency losses. However, as Demirguc-Kant, Leaven and Levine (2003) mention, the second-best move towards competition is not necessarily efficient: "... there is no reason to expect that an increase in the degree of competition and a reduction of concentration in the credit industry would necessarily improve the efficiency of intermediation". In other words, starting from monopoly, slight move towards competition will not guarantee efficiency improvement. Therefore, it is interesting to clarify consequences of increasing competition in banking.

This issue is of much scientific and practical interest: being related to industrial organization issues, it allows to evaluate whether anti-monopolization government policy is actually needed, should the government in the face of National Bank of Ukraine (NBU) prevent mergers or, contrary, put more severe restrictions on the minimum value of banking capital in order to encourage large banks and capital concentration.

Number of studies investigate the relation between concentration and banking efficiency, though all of them estimate the later comparing cost and profit of banks. Thus, banks setting high margins (paying low interest on deposits and charging high interest on loans) are among the most efficient. However, such activity increases burden on the real economy, it distorts allocation of borrower resources towards inefficiency. There is a reverse side of bank profit – resources extracted from the real economy, while these resources could stay in production side and create value. Therefore, we use interest spread (difference between loans and deposit rates) as a main indicator of efficiency.

The contribution of our paper is applying different paradygm of banking efficiency, just described. It is not actually new, for example Caner and Kontorovich (2003) conducted a part of their research based on this paradygm. Moreover, we conduct a two-level study, investigating the relationship betwee nconcentration and spread on both micro- and macrolevels, while nobody examined macroeconomic aspects of banking concentration for Ukraine before, which we try to investigate in this study.

The paper is organized as follows: In Chapter 2 we discuss concepts of competition, banking capital concentration and efficiency, the way they are highlighted in the existing literature, and the recent findings concerning the effect of banking capital concentration on efficiency. In Chapter 3 we describe and justify the methodology of our research, discuss methodological problems that arise in research of this kind and specify the data used. Data descriptions and analysis of specific features of the data appear in Chapter 4. Empirical results and findings are highlighted in Chapter 5, and Chapter 6 represents conclusions that can be inferred from empirical results, and policy implications.

Chapter 2

LITERATURE REVIEW

Numerious studies are dedicated to evaluating banking efficiency and searching for the impact of competition on growth (for example, Deida and Fattonh, 2002, Cetorelli and Peretto, 2000). However, slightly less attention was paid to the interrelation between concentration and efficiency. Probably, one of the reasons for that was difficulty with bringing together such phenomena as concentration and efficiency: both of them are composite phenomena and there is no definite formula for measuring them. However, they can be evaluated using relevant proxies.

In general, efficiency means achieving certain result with the minimum costs. Efficiency in banking, though, can not be simply proxied by profitability if we want to estimate efficiency in the context of the whole society: banks' profits is the reverse side of their clients' costs, so efficiency needs more complicated esimation. In the existing literature the following types of efficiency are mentioned (Caner and Kontorovich, 2003):

- Technical efficiency, which presumes the minimum value of inputs used to produce certain amount of output;
- Allocational efficiency, which requires marginal products and marginal costs to be equated.

Allocational efficiency, though, is more difficult to estimate than technical efficiency (marginal products as first derivatives of empirically approximated but unknown function are hard to compute precisely), however as Caner and

Kontorovich (203) argue, these two types of efficiency are highly correlated across banks since efficient input structure (allocation efficiency) helps to achieve technical efficiency (re-destribution of input weights in such a way that a given level of output is achieved with the minimum costs.

Once the concept of efficiency has been introduced, the question how to measure efficiency arises. There are several approaches to this subject. First of all, it depends on whether we are interested in perfomance of each single bank or banking sector as a whole. For the first case, very often efficiency frontier analysis is applied, which includes a number of parametric and nonparametric methods. However, this variety of methods brings about a shortcoming of frontier approach: although efficiency estimates are similar among banks, different frontier methods may assign different rankings of financial institutions with respect to efficiency (Berger and Humphrey, 1997). Among parametric methods, stochastic frontier approach (SFA) and thick frontier approach (TFA) are usually applied. They require specifying functional form of the frontier and impose certain assumptions on distributions of inefficiency and error term. For example, in SFA random error, or 'idiosyncrasy', is normally distributed, while inefficiency term is an absolute value of normally distributed variable (Greene, 2002). To let more freedom in specifuing the distribution of inefficiency term (which can be drawn from a family of gamma distributions), Bayesian sampling-based computational methods are applied (Sfiridis and Daniels, 2003). Despite the mentioned shortcomings, the main advantage of parametric methods is that they allow to distinguish between systematic inefficiency and random error.

Non-parametric methods do not require specification of frontier functional form, instead they allow to form empirical efficient surface in order to eavaluate relative efficiency of each financial institution. However, there are some statistical problems with its implementation (for example, sensitivity to outliers, impossibility to distinguish the random error). Thus, there is a trade-off between features of both parametric and non-parametric methods, and the choice between them depends on the goals of research.

Empirical studies on this subject provide mixed results: though many papers indicate that large banks on average operate more efficiently (Clark and Siems, 1997, Shepetko, 2004, Fuentes and Vergara, 2003), some works indicate absense of the economy of scale (Caner and Kontorovich, 2003, Berger and Humphrey, 1993) or opposite results for different kinds of efficiency: according to Yildrim and Philippatos (2003) higher concentration leads to higher cost but lower profit efficiency of banks in transition countries.

To avoid sophisticated statistical methods, efficiency on the microlevel can be proxied by interest rate spread (Novoseletska, 2002, Caner and Kontorovich, 2003), which is equal to the difference between average rates on loans and deposits, and it is somewhat similar to the net interest margin (the difference between interest income and interest expenditures divided by the value of interest-bearing assets), applied in their analysis by Demirguc-Kunt, Laeven and Levine (2003).

In order to estimate efficiency of the whole banking sector, often interest spread is calculated (Caner and Kontorovich, 2003), however now it includes rates on loans and deposits average for the banking sector, as proposed by Novoseletska (2002). It should me mentioned that banking capital concentration has wide implications for the whole economy: through affecting efficiency of the banking sector, it influences various branches of the whole economy and therefore economic growth. Results of the studies investigating consequences of banking capital concentration on the macrolevel are ambiguous: various studies found concentration being positively or negatively dependent on growth; even within a single study, the results are opposite for different country groups (Deida and

Fattonh, 2002). High concentration of banking system is not necessarily bad: though reflecting weak competition, it might signal ability to provide big loans to large firms (Petersen and Rajan, 1994) and represent strength of the banking system (Prozorov, 2003). As for efficiency, some papers indicate even the absence of significant relation between concentration and efficiency, taking into account regulatory measures and institutional environment (Demirguc-Kunt, Laeven and Levine, 2003). This ambiguity can be explained by wide heterogeneity of economic systems, there is a myriad of factors influencing efficiency in different countries.

Meanwhile, the concept of competition deserves a special discussion. In industrial organization literature perfect competition is characterized by absence of market power in price-setting. As Dam and Sanchez-Pages (2004) mention, competitive environment lowers bank's profits; in general, the higher is degree of monopolization, the more powerful each firm is in setting higher price and extracting additional margin. That is why departures from competition are usually regarded as efficiency lost. However, Deida and Fattonh (2002) argue that due to complicated market interrelations, moving towards competition in banking industry does not guarantee Pareto improvement. So, it is interesting to investigate the trade-off between competition and efficiency taking banking industry as an example. However, competition should be measured somehow; it is a complex indicator that characterizes market structure, but in the most simplified manner competition can be proxied by concentration of banking capital, accepted by majority of economists (Demirguc-Kunt, Levine, 2000, Deida and Fattonh, 2002).

On the microlevel, though, competition is often related to market power of each bank, which can be proxied by share of each bank in total assets. Also, there is a transitional approach: Petersen and Rajan (1997) suggest using local markets' geographical or credit portfolio concentration of banks as proxies for market power, which is relevant if the whole region we are interested in is sufficiently large and can be meaningfully partitioned into segments.

Examining relationships among concentration and efficiency on both levels is elevant since it helps check consistency of our study: whether certain relations on the microlevel could be replicated on the macrolevel.

Application of results obtained for other countries to Ukrainian economy seems to be doubtful, and the author tries to verify the consequences of concentration specifically for Ukraine. The existing studies on Ukrainian banking sector are helpful but not numerous, and they investigate efficiency in the profile of each single bank. There is no study dealing with macroeconomic aspects of banking capital concentration for Ukraine. In general, Ukrainian banking sector is found to be one of the less efficient among transition economies (Grigorian and Manole, 2002). Though the studies come up with ambiguous results: according to Shepetko (2004), large banks in Ukraine operate more efficiently, while Mertens and Urga (2001) report that large banks have higher profit efficiency but lower cost efficiency. Thus, there is a prospective to conduct integrated research, which will concern both micro and macroeconomic factors.

Chapter 3

METHODOLOGY

We do two-level study in order to decompose effects that occur on the macrolevel and investigate the relation deeper. Specifically, overall impact of concentration on efficiency may arise from:

- Economy of scale, which arises thorough two channels: first, decreasing overhead costs with respect to bank size; second, reduction of interest and non-interest costs through portfolio diversification (larger banks are able to diversify their portfolio better) and access of large stable banks to cheeper sources of funds, which lowers interest costs;

- Exercising of market power by influential banks: the larger is the bank, the more market power it has in order to set higher margin, which is detrimental for intermediation efficiency.

These effects will be captured on the microlevel using the data for all Ukrainian banks, and in order to see which of the effects dominates, we should refer to the macrolevel. Unfortunately, in the framework of our study we are not able to investigate the role of portfolio diversification and access to cheap wholesale market of loanable funds since we don't have access to such kind of information. Methods applied in our analysis depend on the level of investigation.

1. **Macrolevel** There are two main indicators that are looked at especially attentively: concentration and efficiency.

Banking capital concentration is measured usually as a share of several largest banks' assets in the total assets of the system. The most frequent case is to take 3 or 5 (so-called CR5 index) largest banks. This method is easy to apply, however it leads to loss of information about other banks. Another method could be suitable: the rate of concentration could be measured by Herfindahl-Hirshman index, which can be estimated by the formula:

$$HHI = \sum_{i=1}^{n} S_i^2 ,$$

where S_i is the share of i-th bank in total value of banking system assets,

n is the number of banks.

Since shares are from 0 to 1, the maximum value of HHI is 1, which indicates monopoly. However there is no minimum value: the index reaches its greatest lower bound (equal to zero) asymptotically if $n \to \infty$ and neither share dominates the sum. So, the higher HHI is, the more monopolized the market is.

There are some other measures of concentration, in particular Gini concentration ratio, which is good when one examines *inequality* of distribution, however it has a substantial shortcoming when our goal is to investigate the *market power*: consider one economy where there are 2 firms with equal shares, and the other with 10 identical firms. Gini coefficient is the same for both economies since there is perfect equality of assets distribution, however monopolization is higher in the first case. Therefore, we choose Herfindahl-Hirshman index as a measure of concentration.

Another query is whether to use in our analysis concentration of assets, credit portfolio, investment or balance capital. Y. Prozorov (2003) suggests using all of these indicators in his article. It helps distinguish various factors and branches of concentration, so on the macrolevel we used total assets shares, while on the microlevel we applied shares of credit and deposit portfolio while explaining net interest margin, and share of total assets dealing with overhead costs.

Efficiency is proxied by interest spread, which is the difference between average rates on loans and deposits. Actually, there is no consensus how to evaluate efficiency. Some economists suggest using aggregation procedure descibed by Fare, Grosskopf and Zelenyuk (2004), generalizing cost efficiency indicators obtained using DEA (see in micro section). However, this method works when we estimate efficiency from the bank's point of view: it indicates higher profit efficiency when interest spread is higher. But interest spread is a burden on real economy, and in our work we view *intermediation* efficiency, and this point can be presented in the figure below (following Novoseletska, 2002).

There, D and S curves stand for demand and supply of loanable funds, and since banking intermediation has some cost, amount of funds allocated in equilibrium never riches M*, it is always lower than socially optimal level. Interest spread is the difference between R_S and R_D. Now, consider the situation when spread widens from (R_D - R_S) to (R_D^1 - R_S^1), for example, due to a rise in overhead costs, then the amount of allocated funds shrinks even further from M_0 to M^1. Since social welfare function has global maximum at M* and is monotonic at all points, increase in interest spread deteriorates efficiency of banking sector.

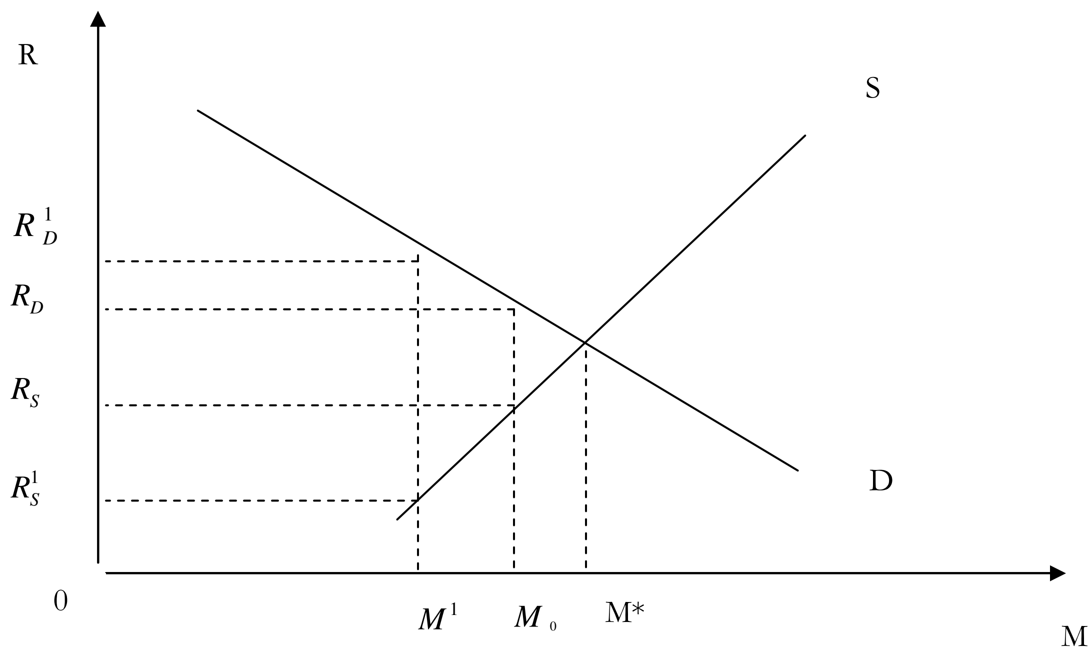


Figure 3.1. Consequences of increasing interest spread

Actually, the time-series used are shown to be non-stationary (ADF test), which presents a problem of spurious regression, when significant coefficients are only due to common trend present in variables. Therefore, the next step is to check whether time-series are cointegrated. Applying Johanssen cointegration test we found that actually the series are cointegrated (see Appendix C), therefore we should estimate Vector Error Correction Model. We take into account all the three measures of concentration due to some features of the data (namely, absence of cointegration among the HHI, CR3 and CR5).

We include spread, concentration index, inflation, NBU refinancing rate and money supply as endogenous variables. Inflation is a-priory necessary in this regression since it enhances information asymmetry, and simply eats out bank profit; theoretically higher inflation is associated with higher spread. NBU refinancing rate should be included since it increases costs of financial intermediation and is expected to have positive relation to spread. Specification of VECM equation for spread is the following (the same is for CR3 and CR5):

$$\Delta Spread_t = \gamma(Spread_{t-1} - \beta_1 HHI_{t-1} - \beta_2 Infl_{t-1} - \beta_3 \operatorname{Re} f\_NBU_{t-1}) + \\ + \alpha_1 \cdot \Delta HHI_{t-1} + \alpha_2 \cdot \Delta Infl_{t-1} + \alpha_3 \cdot \Delta Ln\_\operatorname{Re} f_{t-1} + \alpha_0 + \varepsilon_t$$

where subscript t denotes time period (3rd quarter of 1998 – 4th quarter of 2004),

Spread is interest spread measured in %,

Infl is inflation (log of prices),

Ln_Ref is natural logaritm of NBU refinancing rate ,

ε_t is white noise.

We use logarithm of refinancing rate in order to capture effect of *relative* change in it on spread, rather than absolute change. VECM captures two main effects: immediate responses of each variable on shocks, and adjustment to equilibrium (the speed of convergence to equilibrium whenever it is disturbed), captured in the error correction part, which characterizes self-regulatory properties of the system (stability). It allows to determine long-run relationship between endogenous variables, which is important since we are interested not only in short-run effects, but on the core interrelation between concentration and spread.

A-priory, we expect $\beta_2 > 0$ and $\beta_3 > 0$, while the sign of β_1 is ambiguous and represents the effect of concentration on efficiency; if it is positive, we can infer that higher monopolization is detrimental for efficiency. Though, if β_1 in different regressions will not have the same sign, it will complicate our inferences (but it is unlikely since HHI, CR3 and CR5 are highly correlated). γ is normally negative and less than unity and shows the fraction of initial deviation from equilibrium covered during each period following the disturbance. Immediate response coefficients are expected to have the same sign as correspondent betas.

Microlevel. In this part, we choose two different proxies for efficiency:

1) net interest margin (the reason why we preferred it to various efficiency scores see above) ;
2) share of overhead costs in total costs (OC).

In these two cases we chose slightly different proxies for concentration. Dealing with margin we measure concentration as geometric average of bank's loan share and deposit share. We prefer this measure over asset share since the former captures bank's *presence* at the market, which influences price setting and, therefore, margin. Considering overhead costs, we proxy concentration by share of each bank's assets in total assets of the banking system. Such choice is due to the fact that personnel expenses, building and machine service, being main components of overhead costs, depend on the real capital (assets) the bank owns.

We prefer cross-section over panel data estimation since one of the regressors, Term (which appears important for spread) is available for only three quarters of 2002. We run the following regressions on cross-section data:

1)MARGIN = C(1)*SH_LOAN_DEP + C(2)*INTERBANK +
+ C(3)*FS + C(4)*TERM + C(5)*EQ + C(6)

where MARGIN is net interest margin;
SH_LOAN_DEP is geometric average of bank's loan share and deposit share;
INTERBANK is the share of interbank loans in credit portfolio
FS is financial stability (ratio of assets to liabilities),

TERM is geometric average of weights of term deposits of individuals and term deposits of enterprises in respective amounts of attracted funds;
EQ is the value of investment in equities (thousand dollars).

The sign of C(1) shows the impact of concentration on spread: if it is negative, we can infer that higher market power improves efficiency, and vice versa. Integrated measure is necessary since we cannot include SH_LOANS and SH_DEP distinctly since they are highly correlated.

Interbank loans is the most expensive source of funds, so we expect that C(2)>0: the more expensive inputs used, the higher margin the bank sets in order to offset costs.

The relation between financial stability and spread is ambiguous: from the one hand, more stable institutions are more efficient and have lower spread, but from another hand excess financial stability is a burden since it imposes restrictions which lower operating capital and deteriorate efficiency. Thus, the sign of C(3) should be tested, but if we actually find it equals to zero, it means that either financial stability has no impact on efficiency or the two described effects cancel each other, so the precise answer will not be clear.

TERM shows the average share of stable funds, and fund stability lowers risk and hence lowers required risk premium, decreasing interest margin, so we expect C(4)<0.

Investment is taken into account since equities portfolio is the riskiest part of assets, meaning that those banks with high share of investments are expected to set higher margin due to higher uncertainty, thus we expect C(5)>0.

2) OC = C(1)*(1/SH_ASSETS) + C(2)*SH_CAP + C(3),

where OC is the share of overhead cost in total costs,
SH_ASSETS is the share of bank's assets in total assets of banking system;
SH_CAP is the share of physical capital in total assets.

As can be seen from the diagram below, we should use reciprocal specification for SH_ASSETS rather than linear one.

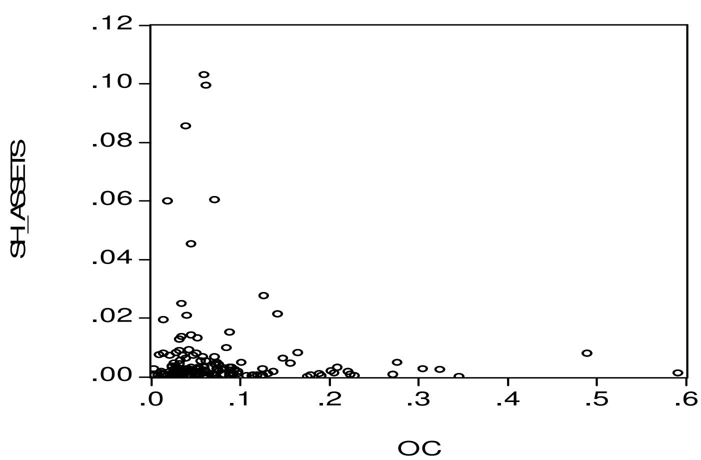


Figure 3.2. Share of overhead cost in total costs vs bank size.

We expect C(1)>0, because in this case margin negatively depends on bank size (hyperbola), which corresponds to economy of scale. C(2) is expectd to be also positive, since physical capital is one of the main sources producing overhead costs.

The main possible problem here is the presence of heteroscedasticity, which is the usual problem of cross-section data. We reveal it using White heteroscedasticity test and apply corrected estimators.

Chapter 4

DATA DESCRIPTION

We use two types of data in our analysis:

1) Time-series quarterly data covering the period from the 3[rd] quarter of 1998 till the 4[th] quareter of 2004. For inflation we add data for the 2[nd] quarter of 1998 in order not to lose observations while running first-differencies regression. The data includes the following aggregated indicators concerning banking system: interest spread (difference between average rates on loans and deposits, % per annum), inflation, NBU refinancing rate, total value of loans and deposits; CR 3, CR 5 and Herfindahl-Hirshman indices as measures of concentration. The data is taken from NBU's website www.bank.gov.ua., except for concentration indices, which were calculated using the data concerning each bank.

Some indicators were transformed for convenience of analysis. In particular, inflation was calculated as natural logarithm of inflation index keeping June 1998 as a base (inflation = 0 since index of inflation equals 1). Inflation index, in turn, was calculated by the principle of Fisher's index as geometrical average of consumer price index (I_{CPI}) and manufacturer's price index (I_{MPI}) :

$$I_{\inf l} = \sqrt{I_{CPI} \cdot I_{MPI}}$$

Data on inflation and NBU refinancing rate was available monthly but concentration indices – only quarterly, so we averaged the former across three monthes of each quarter: we calculated it as geometric averages since both indicators are rates.

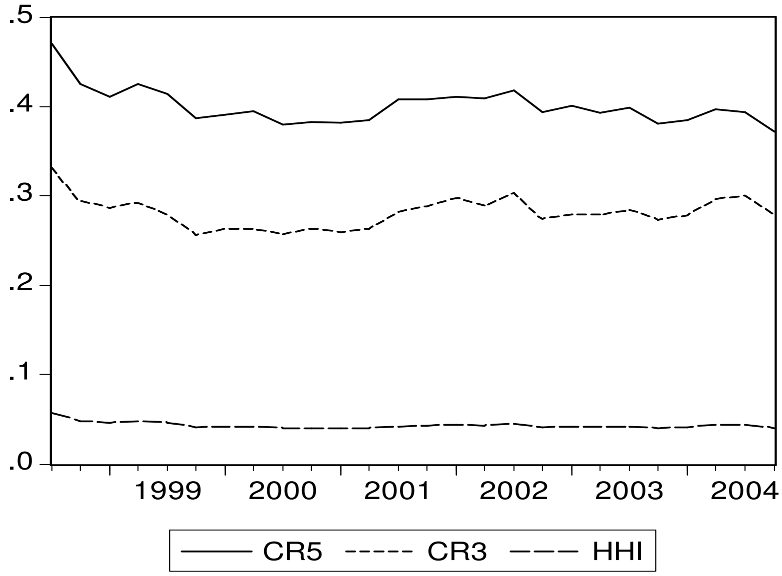


Figure 4.1. Dynamics of banking capital concentration in Ukraine

As can be seen from figure 4.1., concentration of banking assets fluctuates a bit, but the general trend is declining. This means that Ukrainian banking sector becomes more competitive, and market power of each single bank on average decreases. Intuitively, the mentioned three measures of concentration should behave similarly since they desrcribe the same economic phenomena. Data analysis supports this statement: pairwise correlations between them are reasonably high (see below).

Table 4.1. Pairwise correlation between three measures of concentration

	CR5	CR3	HHI
CR5	1	0.8148	0.9542
CR3	0.81483	1	0.8043
HHI	0.9542	0.8043	1

One of the interesting findings of this paper is the absence of cointegration among these measures of concentration (see Appendix B), that is there is no long-run equilibrium relation between them. So, despite they are closely correlated, we should use all of them in our analysis, not just one.

Table 4.2. Descriptive statistics for time-series data

	SPREAD	HHI	CR5	CR3	REF_NBU	INFL
Mean	16.14412	0.042866	0.400531	0.281020	22.75897	0.033689
Median	14.34853	0.041823	0.395760	0.278928	13.33333	0.029378
Maximum	28.02138	0.056833	0.470042	0.331419	69.66667	0.222860
Minimum	6.125523	0.039374	0.371609	0.256214	7.000000	-0.003650
Std. Dev.	7.525575	0.003772	0.020185	0.017306	19.42002	0.043535
Skewness	0.203737	2.120135	1.535318	0.739485	1.098893	3.151986
Kurtosis	1.524618	8.272506	6.425100	3.883743	3.014053	14.40707
Jarque-Bera	2.538020	49.59414	22.92346	3.215714	5.232999	191.0940
Probability	0.281110	0.000000	0.000011	0.200316	0.073058	0.000000
Sum	419.7471	1.114517	10.41380	7.306516	591.7333	0.909608
Sum Sq.Dev	1415.857	0.000356	0.010186	0.007488	9428.430	0.049277
Observ	26	26	26	26	26	27

What we should worry about is non-stationarity of our series. ADF test (see Appendix A) indicates presence of unit root in each of the variables except for refinancing rate (it is integrated of order 1), namely they are 1st difference-stationary. Johansen cointegration test (Appendix C) indicates that they are cointegrated, therefore we can apply VEC model in our analysis.

2)Cross-section data: information about the structure of assets and liabilities, revenues and costs as of July 1, 2002, capturing 154 banks. Data is taken from *Visnyk NBU*. Descriptive statistics for main indicators is precented below.

Table 4.3. Descriptive statistics for microvariables

	MARGIN	SH_LOAN_DEP	SH_CAP	OC	FS
Mean	0.067430	0.006391	0.079369	0.080684	41.52785
Median	0.055810	0.002205	0.052976	0.055109	1.449287
Maximum	0.342003	0.103474	0.560828	0.591242	5802.286
Minimum	-0.129409	0.000000	0.004019	0.001425	1.106864
Std. Dev.	0.053194	0.014113	0.083769	0.083744	467.9360
Skewness	1.117689	4.435405	2.784078	3.022710	12.23568
Kurtosis	7.943318	24.96534	13.46915	15.09520	151.1169
Jarque-Bera	188.8637	3600.824	902.2309	1173.229	144615.4
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	10.38428	0.984227	12.22281	12.42532	6395.289
Sum Sq. Dev.	0.432921	0.030473	1.073632	1.073001	33501501
Observations	154	154	154	154	154

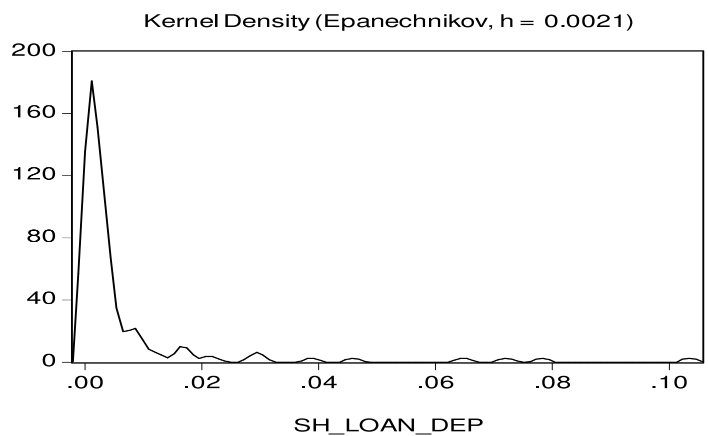
Since there is no data on loan and deposit rates in the profile of each bank, the difference between them (interest spread) should be proxied somehow. In this paper we constructed such proxy in a manner similar to the net interest margin calculation:

$$M\arg in = \frac{Interest\_income - Interest\_\cos ts}{(Loans + Deposits)/2}$$

Unfortunately, net interest margin, more appropriate in this case, can not be calculated from the data we have, since items 'Loans' and 'Deposits' do not capture exclusively sources of interest income and interest expenditures due to balance sheet aggregation. So, it is more convenient to use average among these two items in order to avrage out bias.

OC is the share of overhead costs (other banking operational costs) in total costs and represent management expenditures, physical capital re-novation etc. It represents not productive costs itself, but cost of *organizing* the business. Therefore, it is common practice to view them as a reasonable indicator of efficiency: the lower cost of setting up banking institution, the more sorces available for the institution, therefore efficiency is higher.

SH_LOAN_DEP was calculated as average of each bank's loan share and deposit share. We use geometric average since these two shares have different base (total values of loans and deposits do not coincide). SH_CAP represents the share of each bank physical capital.



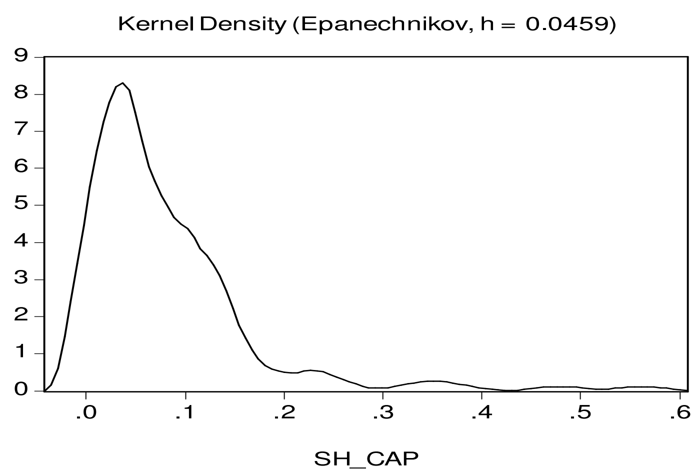


Figure 4.2. Empirical distribution of each bank average loan/deposit shares and physical capital shares.

As can be seen from the figure below, the common feature of these two indicators is high curtosis and assymmetry: very few banks have significant market share, at the same time there is a plenty of banks having negligent market share.

FS is indicator of financial stability, calculated as assets/liabilities sratio. A-priory, it can be greater, equal or higher than unity and shows how many hryvnas of real capital cover 'virtual capital' – liabilities. The higher FS, the more stable the bank is, however excess stability has its drawbacks as well as insufficient stability: in the first case, too many assets sre 'frozen' without being productive, while in the second case risk of bancruptsy is high. As we can see from descriptive statistics table, there is an outlier, whose financial stability is almost 4000 times the median one, therefore it is reasonable to exclude the outlier, which brings serious disturbance and sharpens the problem of heteroscedasticity.

White test (Appendix G) indicates that heteroscedasticity is present in our estimation of factors influencing spread, however it is not the case in equation for overhead costs. So we use White heteroscedasticity corrected estimators in the first case, and apply standard OLS procedure in the second equation.

Chapter 5

RESULTS

5.1. Macrolevel

If we run time-series regression in levels, we receive significant results, which look nice on the first glance. Standard values are presented in ( ), p-values – in [ ] :

SPREAD = 0.495*REF_NBU - 40.544*INFL - 772.566*HHI + 39.42

(0.0506)	(16.0201)	230.446)	(9.263)
[0.0000]	[0.019]	[0.0029]	[0.0003]

SPREAD = 0.403*REF_NBU - 33.475*INFL - 125.21*CR3 + 43.341

(0.0335)	(14.692)	(33.231)	(9.284)
[0.0000]	[0.0328]	[0.0011]	[0.0001]

SPREAD = 0.443*REF_NBU - 37.082*INFL - 95.161*CR5 + 45.475

(0.05)	(17.99)	(42.242)	(16.439)
[0.0000]	[0.0513]	[0.0346]	[0.0113]

However, we cannot trust them since our series are non-stationary: sufficiently high R2 and significant coefficients are due to the common trend present in regressors and dependent variable. Moreover, the coefficient with inflation is strongly expected to be positive, which supports theoretical predictions of coefficints being biased while OLS estimation is applied to levels of non-stationary series.

Taking into account the fact that variables are cointegrated (Appendix C), we apply VECM estimation, which captures two main effects: long-run equilibrium relationship between variables and short-run responses on shocks in each of the series. Specifically, we can estimate the speed of convergence to the long-run equilibrium level of each variable (for us spread is the main point of interest). VECM estimation results are pretty similar for the three measures of concentration, so we present here just the results for CR3, and the others can be seen in Appendix D. Standars errors are given in( ), and correspondingt t-values – in [ ].

```
D(SPREAD) = -0.62 - 0.05*( SPREAD(-1) – 242.03*CR3(-1) –
                 (0.546)  (0.041)                    (103.748)
                [-1.142]  [-1.21]                    [-2.33289]

- 360.27*INFL(-1) -4.8*LN_REF (-1) + 77.6 ) - 0.31*D(SPREAD(-1)) +
(58.0335)            (2.64813)                       (0.25243)
[-6.20798]           [-1.81593]                      [-1.21110]


20.29*D(CR3(-1)) +1.95 *D(INFL(-1)) + 4*D(LN_REF (-1))
(33.6914)            (10.2439)              (4.7)
[ 0.60236]           [ 0.18994]             [ 0.85]
```

$$R^2 = 0.277$$

As can be seen, there is positive and significant long run relationship between interest spread, on the one hand, and concentration measured as CR3, inflation and NBU refinancing rate, on the other hand. Namely, in the long-run 1 percentage point increase in aggregate market share of three largest banks results in 2.42 points increase in spread, additional 1% inflation leads pushes spread up by 3.6 points, and 1 percent increase in NBU refinancing rate is accompanied by 4.8 points increase in spread. The sign of coefficients with inflation and refinancing rate is plausible and was a-priory expected to be positive. Pure empirical finding was positive relation (it is ambiguous in thory) between concentration (results for HHI and CR5 as concentration measures are similar) and spread, that is in the long-run increasing concentration is detrimental for intermediation efficiency.

Meanwhile, the speed of convergence towards equilibrium is quite low: in case of deviation from long-run equilibrium level, only 5% of the gap is covered per each quarter. That is, self-regulation ability of this system is weak, although the system is stable, and in the long-run all variables converge to their steady-state equilibrium levels. Immediate response coefficients, which are with lagged difference terms, are insignificant. However, we traced the 'core' relation between variables from cointegrating relation.

In order to visualize the dynamic behavior of the system, we build impulse response functions and decompose the variance of spread. As can be seen from Appendix(E), positive one standard deviation shock in spread leads to immediate increase in spread during the next quarter, while further it stabilizes gradually at a certain level higher than before the shock. Interesting feature of this reaction is overlapping response in the first period, and stabilization path is smooth and monotonically decreasing. The same shock in HHI produces increase in spread by small amount, overlapping is also present, however it is almost negligible. Thus, we can say that increasing concentration leads to higher spread in the long-run, which is detrimental for allocation efficiency.

However, as can be seen from Appendix F, variance decomposition suggests that concentration explains very little fraction of spread variance (almost zero). In the short run lagged values of spread explain most part of spread variance (up to 11 periods), while in the long-run relative change of NBU refinancing rate becomes the most powerful explanator of spread behaviour (explains appriximately 60% of spread variance after 50 periods), inflation is also important for spread (32%).

Thus, investigation on the macrolevel reveals positive long-run relationship between concentration and spread, with immediate increase in spread after positive concentration shock. We can infer that increasing concentration on average deteriorates intermediation efficiency of Ukrainian banks. However, although concentration has significant positive impact on spread, this impact is not crucial and strong enough, other macroeconomic factors such as NBU refinancing rate and inflation matter much more for spread, and produce most part of spread change.

5.2. Microlevel

We run a cross-section regression to reveal factors that influence net interest margin. In order to avoid heteroscedasticity present in such kind of data (Appendix G), we used White heteroscedasticity-corrected estimators. Standard values are presented in ( ), t-values – in [ ] :

MARGIN = -0.513*SH_LOAN_DEP - 0.075*INTERBANK +0.00003*FS –
(0.143) (0.028) (0.00005)
[-3.576] [-2.697] [0.75]

- 0.093*TERM – 0.003*EQ + 0.126
(0.022) (0.018) (0.013)
[-4.265] [-0.163] [9.92]

$R^2 = 0.296$

It reveals significant scale effect: increase in average share of a bank in credit and deposit segments by 0.01 is accompanied with decrease in margin by 0.005, or 0.5%, since by construction margin can vary from 0 to 1. It means that larger banks tend to set lower margins, and economy of scale dominates exercising of market power.

Surprizingly, the share of interbank loans in total credit portfolio is negatively related to margin, while a-priory this relation was expectd to be positive: interbank loan is the most expensive source of bank funds, so it should push margin up. The negative relation can be explained by the fact that only banks wih good reputation (which can afford to set lower margin) have access to interbank loans.

As expected, the share of stable funds (Term) has negative impact on margin, since fund stability reduces bank risks and brings some benefits, allowing the bank to set lower margins. As can be seen, increasing in share of stable funds by 1 percentage point is associated with fall in margin by approximately 0.1 points.

Financial stability does not matter for margin. Although financial stability has obvious benefits, it is costly for banks: insufficient liabilities result in sacrificing profits, so that banks should set higher margins to maintain the same level of profitability. Thus, either two opposite effects are both insignificant, or they simply cancel each other, and overall effect becomes insignificant.

The amount of equity investment does not have significant impact on margin, although equities is the riskiest category of asset. It can be inferred that risk premium associated with asset holdings is not so mush to influence bank margin.

In order to reveal scale effect, we examine the relation between the size of a bank and its overhead cost.

OC = 0.000022*(1/SH_ASSETS) - 0.0217*SH_CAP + 0.066

(000008)	(0.0803)	(0.0106)
]2.627]	[-0.27]	[6.21]

$$R^2 = 0.044$$

As expected, the coefficient with 1/SH_ASSETS is positive, indicating economy of scale: larger banks, on average, have lower fraction of overhead costs and from this point operate more efficiently. The coefficient, however, is low since mean value of asset share is 0.006, making reciprocal value large.

Share of physical capital appears to be insignificant for overhead costs, which normally should not be the case. We could expect that this type of costs is influenced to great extent by bank administration and vary from one bank to another in a non-systematic way.

At this stage we can infer that larger banks on average set lower margin, which means that economy of scale dominates market power effect. However, such result is contradictory to macro-level findings: recall that in the previous section we found significant positive relation between concentration and spread. What we can infer from micro investigation is that relation between bank size and interest margin is actually negative. Although intuitively both describe the same thing, there is no direct correspondence between them. Due to small number of observations, very low fraction of spread variance explained by concentration dynamic and more than one cointegrating relations we put some doubts on our macro results. The prospective study may include panel data estimation to detect whether there was shift in micro effects over time, which could reconcile macro- and micro-findings.

Chapter 6

CONCLUSIONS AND DIRECTIONS FOR FURTHER RESEARCH

There is bunch of papers investigating banking intermediation efficiency and the role of banking size in it. In this study we try to view the problem from a slightly different point and generalized scale analysis introducing the concept of competition and concentration. Another specefic feature that distinguishes our paper from all existing studies is two-level analysis: we investigate both micro- and macro-aspects of intermediation efficiency and role of banking capital concentration.

Data suggests that since 1998 Ukrainian banking sector becomes more competitive ans less concentrated. Although number of banks declined from 186 banks in July 1998 to 160 banks at the end of 2004, the share of five largest banks declined from 47 to 37%, respectively. In other words, power of 'core' banks declines, small and medium banks play increasingly important role in the economy. At the same time, spread also goes down, suggesting that competition improves intermediation efficiency. However, as we show, such behaviour is only due to common trend present in both series.

Applying ECM reveals in fact significant positive relation between concentration and spread, however such impact is not strong enough: dynamic of concentration index explains negligible part of spread variance, instead there are some macroeconomic factors that matter much more for spread. Namely, increasing NBU refinancing rate and inflation are harmful for intermediation efficiency and push spread up. In the long-run refinancing rate dynamic explains most part of spread behavior (almost 60%).

However, we should not emphasize much on this result since we have small number of observations (26), so results might not be robust. Moreover, there is low variability in concentration indices, which lowers precision of estimation.

Micro investigation reveals positive scale effect in the sense that overhead costs are decresing with respect to bank size, and also larger banks tend to set lower margins, which indicates that economy of scale dominates effect of exercising market power. This result is actually conflicting to those from macro investigation, where we found positive relation between spread and concentration, but both are not directly comparable: macro part tells us about relation between concentration index and spread, while micro study indicates the relation between bank share and margin. Due to some problems mentioned we can not rely much on macro results. What we can say is that actually large banks set lower margins and operate with lower overhead costs, so their intermediation efficiency is higher than the one of small banks.

The novelty of our study is two-level investigation of relation between intermediation efficiency and spread, actually nobody combined macro- and micro-studies before. However, due to some data problems, namely small number of observations for time-series data and only 3 period data available on some important bank-specific variables on the micro-level, the obtained results are not sufficiently reliable. However, our paper may be methodologically useful and produces results future research may orient on, discuss and verify. With sufficient data quality our paper would be useful for policy analysis and determine whether banking sector needs anti-monopolistic regulation or, in contrary, National Bank should impose more severe entry restrictions to enforce concentration and economy of scale.

Among directions of prospective research we see decomposition of scale effect on the micro-level, namely verifying whether access of larger banks to cheaper sources of funds has significant impact on margin (however, one needs exclusive data for this investigation). Important thing is reliability of margin as a proxy for difference between loan and deposit rates. Using exclusive data we could estimate it with much greater precision. Extension of time-series data, if possible, could be very useful for similar macro-level study. Another interesting point is looking into mutual interdependence between banks and determination of the role of bank size in it.

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APPENDIX A. Unit root test of macro variables

Table 1. ADF test for HHI (former – in levels, later – in 1st difference)

ADF Test Statistic	-2.900080	1% Critical Value*	-3.7343
		5% Critical Value	-2.9907
		10% Critical Value	-2.6348

*MacKinnon critical values for rejection of hypothesis of a unit root.

ADF Test Statistic	-5.141474	1% Critical Value*	-3.7497
		5% Critical Value	-2.9969
		10% Critical Value	-2.6381

Table 2. ADF test for CR3 (former – in levels, later – in 1st difference)

ADF Test Statistic	-2.333869	1% Critical Value*	-3.7343
		5% Critical Value	-2.9907
		10% Critical Value	-2.6348

*MacKinnon critical values for rejection of hypothesis of a unit root.

ADF Test Statistic	-4.097465	1% Critical Value*	-3.7497
		5% Critical Value	-2.9969
		10% Critical Value	-2.6381

Table 3. ADF test for CR5 (former – in levels, later – in 1st difference)

ADF Test Statistic	-2.371250	1% Critical Value*	-3.7343
		5% Critical Value	-2.9907
		10% Critical Value	-2.6348

*MacKinnon critical values for rejection of hypothesis of a unit root.

ADF Test Statistic	-5.165176	1% Critical Value*	-3.7497
		5% Critical Value	-2.9969
		10% Critical Value	-2.6381

Table 4. ADF test for SPREAD (former – in levels, later – in 1st difference)

ADF Test Statistic	-0.428134	1% Critical Value*	-3.7204
		5% Critical Value	-2.9850
		10% Critical Value	-2.6318

*MacKinnon critical values for rejection of hypothesis of a unit root.

ADF Test Statistic	-4.058123	1% Critical Value*	-3.7343
		5% Critical Value	-2.9907

		10% Critical Value	-2.6348

Table 5. ADF test for inflation (former – in levels, later – in 1st difference)

ADF Test Statistic	-3.541584	1% Critical Value*	-3.7204
		5% Critical Value	-2.9850
		10% Critical Value	-2.6318

*MacKinnon critical values for rejection of hypothesis of a unit root.

ADF Test Statistic	-11.65511	1% Critical Value*	-3.7343
		5% Critical Value	-2.9907
		10% Critical Value	-2.6348

Table 6. ADF test for LN_REF (in levels, 1st and 2nd differences)

ADF Test Statistic	-2.202744	1% Critical Value*	-3.7343
		5% Critical Value	-2.9907
		10% Critical Value	-2.6348

*MacKinnon critical values for rejection of hypothesis of a unit root.

ADF Test Statistic	-1.383912	1% Critical Value*	-3.7497
		5% Critical Value	-2.9969
		10% Critical Value	-2.6381

ADF Test Statistic	-5.823079	1% Critical Value*	-3.7667
		5% Critical Value	-3.0038
		10% Critical Value	-2.6417

APPENDIX B. Johansen Cointegration Test Among Concentration Indices

Sample(adjusted): 1999:1 2004:4
Included observations: 24 after adjusting endpoints
Trend assumption: Linear deterministic trend
Series: HHI CR3 CR5
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None	0.407131	18.29303	29.68	35.65
At most 1	0.212712	5.746254	15.41	20.04
At most 2	0.000266	0.006397	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates no cointegration at both 5% and 1% levels

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None	0.407131	12.54677	20.97	25.52
At most 1	0.212712	5.739858	14.07	18.63
At most 2	0.000266	0.006397	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Max-eigenvalue test indicates no cointegration at both 5% and 1% levels

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

HHI	CR3	CR5
-382.7065	-36.69603	28.44256
765.8482	-88.15288	-59.77209
682.0961	86.72515	-222.1229

Unrestricted Adjustment Coefficients (alpha):

D(HHI)	0.001056	-0.000430	-1.29E-05
D(CR3)	0.007189	-0.001923	-4.01E-05
D(CR5)	0.006521	-0.000985	-0.000109

APPENDIX C. Johansen Cointegration Test Among Macro Variables

Table 1. Concentration measured by HHI

Sample(adjusted): 1999:1 2004:4
Included observations: 24 after adjusting endpoints
Trend assumption: Linear deterministic trend
Series: SPREAD LN_REF HHI INFL
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.781109	82.45978	47.21	54.46
At most 1 **	0.699572	45.99942	29.68	35.65
At most 2 *	0.333649	17.13832	15.41	20.04
At most 3 **	0.265201	7.395799	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 4 cointegrating equation(s) at the 5% level
Trace test indicates 2 cointegrating equation(s) at the 1% level

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.781109	36.46035	27.07	32.24
At most 1 **	0.699572	28.86111	20.97	25.52
At most 2	0.333649	9.742520	14.07	18.63
At most 3 **	0.265201	7.395799	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Max-eigenvalue test indicates 2 cointegrating equation(s) at both 5% and 1% levels

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

SPREAD	LN_REF	HHI	INFL
-0.164621	0.674586	149.7382	37.86505
-0.037087	1.553845	353.1326	-28.04613
0.702193	-6.832709	97.66306	25.24927
-0.191574	0.279541	317.6438	-15.22733

Unrestricted Adjustment Coefficients (alpha):

D(SPREAD)	0.433257	0.479494	-0.775682	0.397276
D(LN_REF)	0.031371	0.002721	0.010805	0.030640
D(HHI)	-7.87E-05	-0.001238	-0.000676	0.000112
D(INFL)	-0.018898	0.005918	0.002317	0.005429

1 Cointegrating Equation(s): Log likelihood 174.3441

Normalized cointegrating coefficients (std.err. in parentheses)

SPREAD	LN_REF	HHI	INFL
1.000000	-4.097814	-909.5932	-230.0134
	(1.60603)	(383.451)	(39.1053)

Adjustment coefficients (std.err. in parentheses)

D(SPREAD)	-0.071323
	(0.06469)
D(LN_REF)	-0.005164
	(0.00251)
D(HHI)	1.30E-05
	(7.4E-05)
D(INFL)	0.003111
	(0.00065)

2 Cointegrating Equation(s): Log likelihood 188.7747

Normalized cointegrating coefficients (std.err. in parentheses)

SPREAD	LN_REF	HHI	INFL
1.000000	0.000000	24.04295	-336.9309
		(474.148)	(42.3036)
0.000000	1.000000	227.8376	-26.09134
		(55.6755)	(4.96738)

Adjustment coefficients (std.err. in parentheses)

D(SPREAD)	-0.089106	1.037329
	(0.06351)	(0.63756)
D(LN_REF)	-0.005265	0.025390
	(0.00257)	(0.02578)
D(HHI)	5.89E-05	-0.001977
	(5.7E-05)	(0.00058)
D(INFL)	0.002892	-0.003553
	(0.00062)	(0.00622)

3 Cointegrating Equation(s): Log likelihood 193.6459

Normalized cointegrating coefficients (std.err. in parentheses)

SPREAD	LN_REF	HHI	INFL
1.000000	0.000000	0.000000	-338.1578
			(39.3528)
0.000000	1.000000	0.000000	-37.71821
			(4.41201)
0.000000	0.000000	1.000000	0.051031
			(0.01787)

Adjustment coefficients (std.err. in parentheses)

D(SPREAD)	-0.633785	6.337338	158.4447
	(0.23759)	(2.31589)	(130.213)
D(LN_REF)	0.002322	-0.048435	6.713367
	(0.01084)	(0.10562)	(5.93865)
D(HHI)	-0.000416	0.002645	-0.515060
	(0.00022)	(0.00211)	(0.11877)
D(INFL)	0.004518	-0.019384	-0.513656
	(0.00262)	(0.02554)	(1.43616)

Table 2. Concentration measured by CR3

Sample(adjusted): 1999:1 2004:4
Included observations: 24 after adjusting endpoints
Trend assumption: Linear deterministic trend
Series: SPREAD LN_REF INFL CR3
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.785116	83.19178	47.21	54.46
At most 1 **	0.691210	46.28803	29.68	35.65
At most 2 *	0.356710	18.08579	15.41	20.04
At most 3 **	0.268322	7.497942	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 4 cointegrating equation(s) at the 5% level
Trace test indicates 2 cointegrating equation(s) at the 1% level

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.785116	36.90374	27.07	32.24
At most 1 **	0.691210	28.20224	20.97	25.52
At most 2	0.356710	10.58785	14.07	18.63
At most 3 **	0.268322	7.497942	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Max-eigenvalue test indicates 2 cointegrating equation(s) at both 5% and 1% levels

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

SPREAD	LN_REF	INFL	CR3
-0.105530	0.507478	38.01949	25.54188
-0.228758	0.104620	17.93618	-67.16871
-0.649530	6.787724	-28.75029	-15.48101
-0.357192	2.725281	-19.15518	50.17440

Unrestricted Adjustment Coefficients (alpha):

D(SPREAD)	0.472649	-0.280209	0.734803	0.533665
D(LN_REF)	0.026693	-0.006915	-0.019896	0.029429
D(INFL)	-0.020296	-0.006294	-0.002785	0.004847
D(CR3)	-0.000409	0.008131	0.003403	0.000805

1 Cointegrating Equation(s): Log likelihood 130.7821

Normalized cointegrating coefficients (std.err. in parentheses)

SPREAD	LN_REF	INFL	CR3
1.000000	-4.808836	-360.2707	-242.0336
	(2.64813)	(58.0335)	(103.748)

Adjustment coefficients (std.err. in parentheses)

D(SPREAD)	-0.049879
	(0.04125)
D(LN_REF)	-0.002817
	(0.00169)
D(INFL)	0.002142
	(0.00042)
D(CR3)	4.32E-05
	(0.00028)

2 Cointegrating Equation(s): Log likelihood 144.8832

Normalized cointegrating coefficients (std.err. in parentheses)

SPREAD	LN_REF	INFL	CR3
1.000000	0.000000	-48.78294	349.9201
		(29.6585)	(62.7493)
0.000000	1.000000	64.77405	123.0971
		(11.9916)	(25.3710)

Adjustment coefficients (std.err. in parentheses)

D(SPREAD)	0.014221	0.210544
	(0.09705)	(0.19961)
D(LN_REF)	-0.001235	0.012823
	(0.00401)	(0.00824)
D(INFL)	0.003582	-0.010958
	(0.00092)	(0.00189)
D(CR3)	-0.001817	0.000643
	(0.00048)	(0.00098)

3 Cointegrating Equation(s): Log likelihood 150.1772

Normalized cointegrating coefficients (std.err. in parentheses)

SPREAD	LN_REF	INFL	CR3
1.000000	0.000000	0.000000	410.7637
			(70.5487)
0.000000	1.000000	0.000000	42.30882
			(8.28894)
0.000000	0.000000	1.000000	1.247232
			(0.30257)

Adjustment coefficients (std.err. in parentheses)

D(SPREAD)	-0.463056	5.198187	-8.181806
	(0.23973)	(2.34248)	(17.5249)
D(LN_REF)	0.011688	-0.122228	1.462843
	(0.01059)	(0.10346)	(0.77405)
D(INFL)	0.005391	-0.029864	-0.804450
	(0.00250)	(0.02444)	(0.18284)
D(CR3)	-0.004027	0.023742	0.032449
	(0.00119)	(0.01167)	(0.08729)

Table 3. Concentration measured by CR5

Sample(adjusted): 1999:1 2004:4
Included observations: 24 after adjusting endpoints
Trend assumption: Linear deterministic trend
Series: SPREAD LN_REF INFL CR5
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.790593	82.69633	47.21	54.46
At most 1 **	0.689691	45.17291	29.68	35.65
At most 2 *	0.370080	17.08843	15.41	20.04
At most 3 *	0.221087	5.996530	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 4 cointegrating equation(s) at the 5% level
Trace test indicates 2 cointegrating equation(s) at the 1% level

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.790593	37.52341	27.07	32.24
At most 1 **	0.689691	28.08449	20.97	25.52
At most 2	0.370080	11.09190	14.07	18.63
At most 3 *	0.221087	5.996530	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Max-eigenvalue test indicates 2 cointegrating equation(s) at both 5% and 1% levels

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

SPREAD	LN_REF	INFL	CR5
-0.156821	0.686946	40.85363	26.56569
0.016426	-1.605586	22.67195	-57.55106
0.746641	-6.858509	31.73632	-2.398223
-0.024187	1.486882	0.310394	-59.53510

Unrestricted Adjustment Coefficients (alpha):

D(SPREAD)	0.525771	-0.534669	-0.857523	-0.224985
D(LN_REF)	0.029263	0.005379	0.003322	-0.029856
D(INFL)	-0.019311	-0.004939	0.000576	-0.005374
D(CR5)	-0.000722	0.005914	-0.004168	0.001181

1 Cointegrating Equation(s): Log likelihood 134.5170

Normalized cointegrating coefficients (std.err. in parentheses)

SPREAD	LN_REF	INFL	CR5
1.000000	-4.380433	-260.5105	-169.4009
	(1.59965)	(39.8626)	(67.0650)

Adjustment coefficients (std.err. in parentheses)

D(SPREAD)	-0.082452
	(0.06078)
D(LN_REF)	-0.004589
	(0.00243)
D(INFL)	0.003028
	(0.00060)
D(CR5)	0.000113
	(0.00038)

2 Cointegrating Equation(s): Log likelihood 148.5593

Normalized cointegrating coefficients (std.err. in parentheses)

SPREAD	LN_REF	INFL	CR5
1.000000	0.000000	-337.4895	-12.96871
		(37.7603)	(80.2382)
0.000000	1.000000	-17.57338	35.71159
		(4.21177)	(8.94973)

Adjustment coefficients (std.err. in parentheses)

D(SPREAD)	-0.091235	1.219633
	(0.05779)	(0.64004)
D(LN_REF)	-0.004501	0.011465
	(0.00244)	(0.02700)
D(INFL)	0.002947	-0.005337
	(0.00058)	(0.00639)
D(CR5)	0.000210	-0.009992
	(0.00031)	(0.00342)

3 Cointegrating Equation(s): Log likelihood 154.1052

Normalized cointegrating coefficients (std.err. in parentheses)

SPREAD	LN_REF	INFL	CR5
1.000000	0.000000	0.000000	508.6185
			(121.540)
0.000000	1.000000	0.000000	62.87110
			(13.3780)
0.000000	0.000000	1.000000	1.545491
			(0.38502)

Adjustment coefficients (std.err. in parentheses)

D(SPREAD)	-0.731497	7.100961	-17.85696
	(0.23330)	(2.16374)	(17.2681)
D(LN_REF)	-0.002020	-0.011321	1.422885
	(0.01178)	(0.10927)	(0.87201)
D(INFL)	0.003377	-0.009286	-0.882638
	(0.00279)	(0.02589)	(0.20664)
D(CR5)	-0.002901	0.018592	-0.027657
	(0.00129)	(0.01200)	(0.09577)

APPENDIX D. VECM estimation results for spread

1. Treating HHI as a measure of concentration

Sample(adjusted): 1999:1 2004:4
Included observations: 24 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1			
SPREAD(-1)	1.000000			
HHI(-1)	-5076.099 (1513.32) [-3.35429]			
INFL(-1)	-1.404424 (151.816) [-0.00925]			
REF_NBU(-1)	-2.186773 (0.36112) [-6.05558]			
C	245.9907			
Error Correction:	**D(SPREAD)**	**D(HHI)**	**D(INFL)**	**D(REF_NBU)**
CointEq1	-0.032044 (0.01891) [-1.69497]	5.57E-05 (1.8E-05) [3.11113]	-0.000109 (0.00026) [-0.42463]	0.001981 (0.02122) [0.09336]
D(SPREAD(-1))	-0.425561 (0.27781) [-1.53185]	0.000282 (0.00026) [1.07199]	-0.005480 (0.00377) [-1.45309]	-0.843075 (0.31178) [-2.70409]
D(HHI(-1))	98.97128 (202.139) [0.48962]	-0.505298 (0.19157) [-2.63766]	4.207430 (2.74416) [1.53323]	682.6779 (226.855) [3.00932]
D(INFL(-1))	4.692038 (8.50869) [0.55144]	-0.005681 (0.00806) [-0.70444]	-0.460687 (0.11551) [-3.98826]	0.863088 (9.54906) [0.09038]
D(REF_NBU(-1))	0.332208 (0.21237) [1.56432]	-0.000453 (0.00020) [-2.24841]	0.006363 (0.00288) [2.20702]	0.506618 (0.23833) [2.12568]
C	-0.191923	-0.001593	0.008287	-1.233882

	(0.61721)	(0.00058)	(0.00838)	(0.69267)
	[-0.31095]	[-2.72398]	[0.98904]	[-1.78133]
R-squared	0.277010	0.440487	0.703377	0.698718
Adj. R-squared	0.076179	0.285067	0.620982	0.615029
Sum sq. resids	63.74795	5.73E-05	0.011749	80.29009
S.E. equation	1.881901	0.001784	0.025548	2.112004
F-statistic	1.379320	2.834165	8.536615	8.348939
Log likelihood	-45.77712	121.2977	57.41043	-48.54563
Akaike AIC	4.314760	-9.608144	-4.284202	4.545469
Schwarz SC	4.609274	-9.313631	-3.989689	4.839983
Mean dependent	-0.792763	-0.000352	-0.007286	-2.322222
S.D. dependent	1.957956	0.002109	0.041498	3.403929
Determinant Residual Covariance		8.66E-09		
Log Likelihood		100.3675		
Log Likelihood (d.f. adjusted)		86.55875		
Akaike Information Criteria		-4.879896		
Schwarz Criteria		-3.505500		

2. Treating CR3 as a measure of concentration

Sample(adjusted): 1999:1 2004:4
Included observations: 24 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1			
SPREAD(-1)	1.000000			
CR3(-1)	-5370.873			
	(1250.72)			
	[-4.29423]			
INFL(-1)	-823.8495			
	(812.365)			
	[-1.01414]			
REF_NBU(-1)	-12.65609			
	(1.92865)			
	[-6.56213]			
C	1783.024			
Error Correction:	D(SPREAD)	D(CR3)	D(INFL)	D(REF_NBU)
CointEq1	-0.007131	4.49E-05	1.12E-05	0.001080
	(0.00327)	(2.1E-05)	(4.8E-05)	(0.00409)

	[-2.17806]	[2.09749]	[0.23398]	[0.26418]
D(SPREAD(-1))	-0.579139	0.000958	-0.004069	-0.845192
	(0.29519)	(0.00193)	(0.00431)	(0.36853)
	[-1.96193]	[0.49627]	[-0.94355]	[-2.29341]
D(CR3(-1))	39.62941	-0.422767	0.421703	103.4573
	(34.2276)	(0.22381)	(0.50008)	(42.7318)
	[1.15782]	[-1.88895]	[0.84327]	[2.42109]
D(INFL(-1))	1.104947	-0.002537	-0.468615	-3.429551
	(8.65445)	(0.05659)	(0.12645)	(10.8047)
	[0.12767]	[-0.04483]	[-3.70606]	[-0.31741]
D(REF_NBU(-1))	0.416982	-0.002034	0.005098	0.508214
	(0.21549)	(0.00141)	(0.00315)	(0.26903)
	[1.93503]	[-1.44355]	[1.61922]	[1.88905]
C	-0.081471	-0.005823	0.004222	-1.474845
	(0.58240)	(0.00381)	(0.00851)	(0.72710)
	[-0.13989]	[-1.52899]	[0.49623]	[-2.02840]
R-squared	0.334534	0.314736	0.683766	0.656821
Adj. R-squared	0.149682	0.124385	0.595924	0.561494
Sum sq. resids	58.67592	0.002509	0.012525	91.45535
S.E. equation	1.805484	0.011806	0.026379	2.254075
F-statistic	1.809740	1.653452	7.783988	6.890161
Log likelihood	-44.78223	75.93754	56.64220	-50.10809
Akaike AIC	4.231853	-5.828128	-4.220183	4.675674
Schwarz SC	4.526366	-5.533615	-3.925670	4.970188
Mean dependent	-0.792763	-0.000717	-0.007286	-2.322222
S.D. dependent	1.957956	0.012617	0.041498	3.403929
Determinant Residual Covariance		3.60E-07		
Log Likelihood		55.64781		
Log Likelihood (d.f. adjusted)		41.83907		
Akaike Information Criteria		-1.153256		
Schwarz Criteria		0.221140		

3. Treating CR5 as a measure of concentration

Sample(adjusted): 1999:1 2004:4
Included observations: 24 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

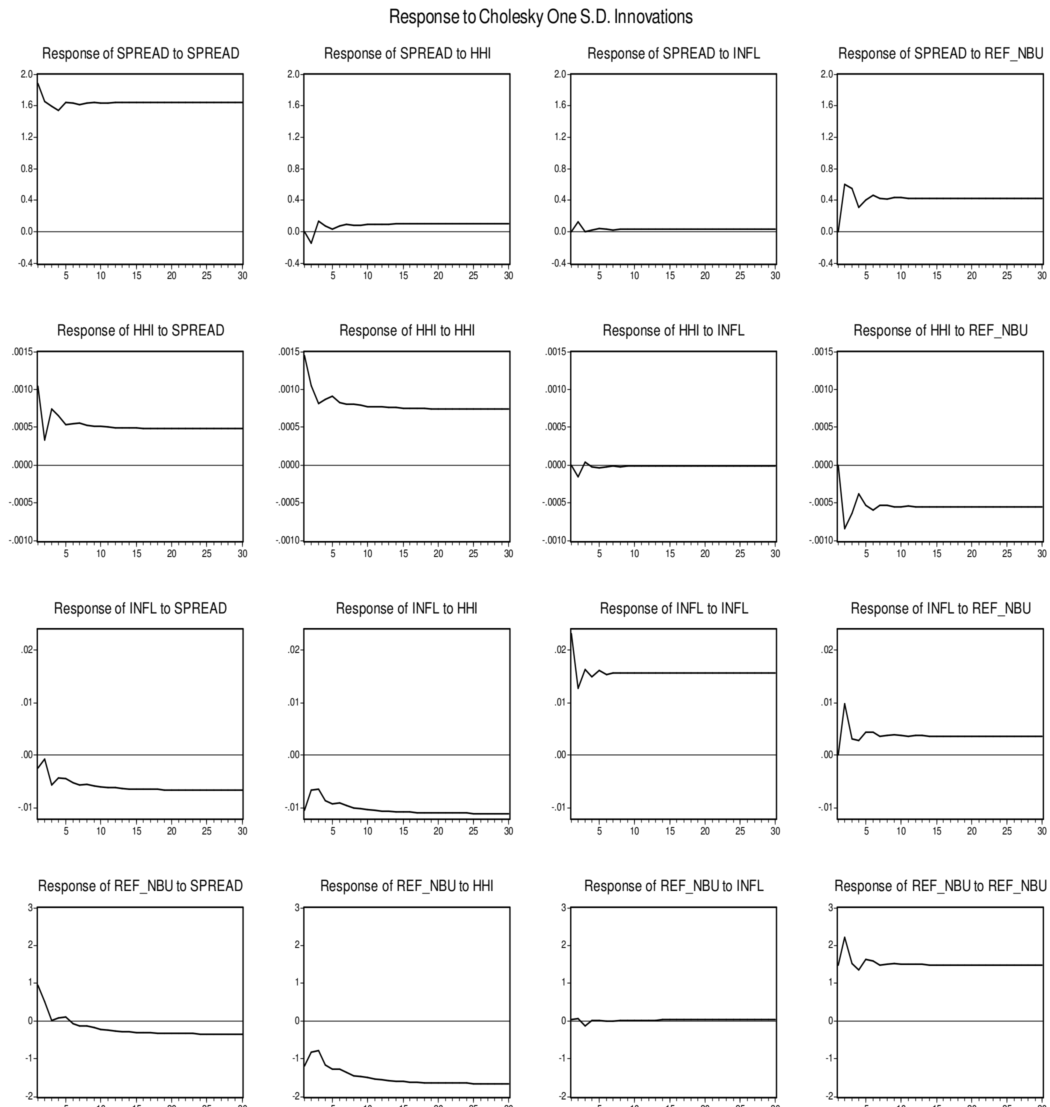
Cointegrating Eq:	CointEq1			

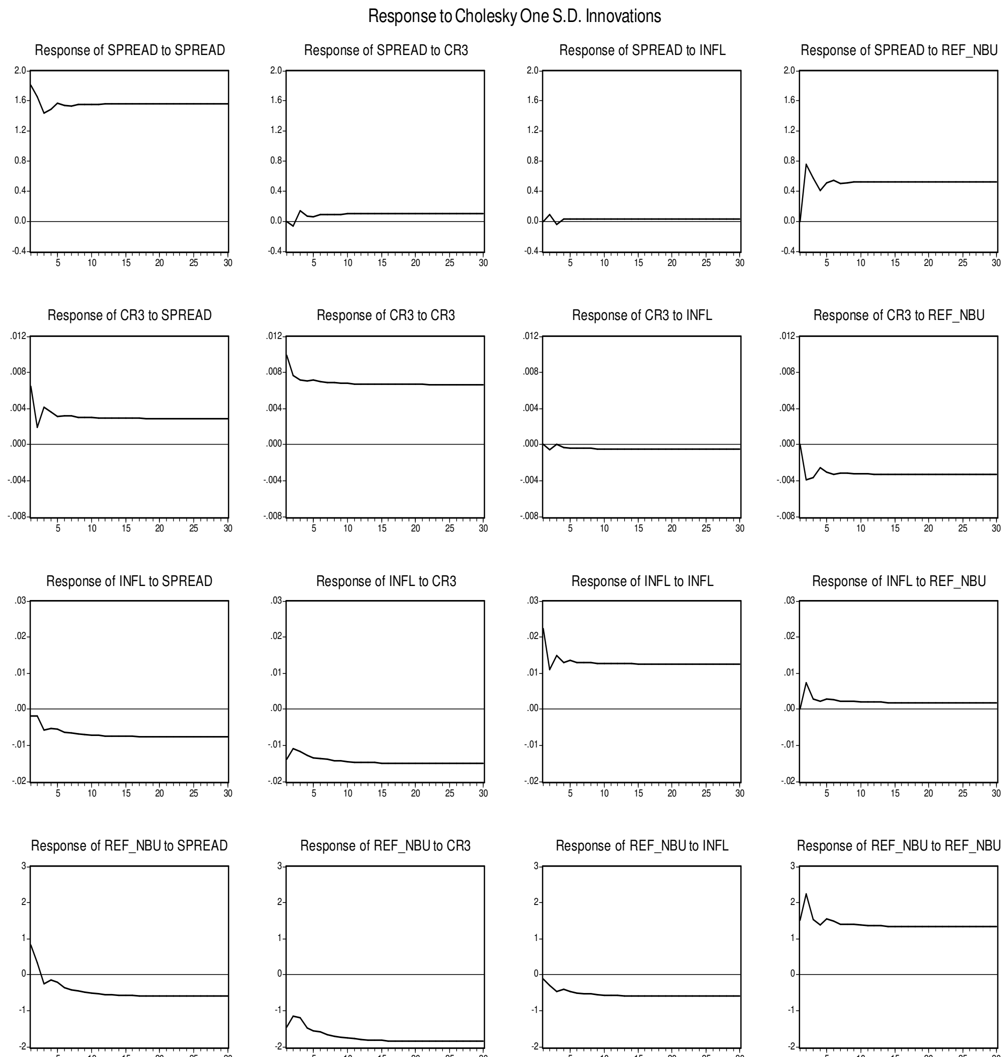
SPREAD(-1)	1.000000
CR5(-1)	-4148.018
	(975.849)
	[-4.25068]
INFL(-1)	-2032.027
	(649.715)
	[-3.12757]
REF_NBU(-1)	-6.977635
	(1.30986)
	[-5.32702]
C	1860.467

Error Correction:	D(SPREAD)	D(CR5)	D(INFL)	D(REF_NBU)
CointEq1	-0.007542	6.01E-05	2.95E-05	0.002857
	(0.00415)	(2.3E-05)	(5.7E-05)	(0.00488)
	[-1.81700]	[2.60553]	[0.52100]	[0.58510]
D(SPREAD(-1))	-0.470241	0.000580	-0.002805	-0.685977
	(0.28777)	(0.00160)	(0.00392)	(0.33857)
	[-1.63409]	[0.36251]	[-0.71524]	[-2.02609]
D(CR5(-1))	26.82155	-0.503572	0.505206	94.91604
	(34.0895)	(0.18959)	(0.46457)	(40.1077)
	[0.78680]	[-2.65611]	[1.08746]	[2.36653]
D(INFL(-1))	-2.645261	0.004233	-0.409831	0.989035
	(10.4415)	(0.05807)	(0.14230)	(12.2848)
	[-0.25334]	[0.07290]	[-2.88011]	[0.08051]
D(REF_NBU(-1))	0.386258	-0.002920	0.004245	0.440643
	(0.22917)	(0.00127)	(0.00312)	(0.26962)
	[1.68549]	[-2.29125]	[1.35929]	[1.63429]
C	-0.043916	-0.010920	0.003888	-1.376356
	(0.65088)	(0.00362)	(0.00887)	(0.76579)
	[-0.06747]	[-3.01654]	[0.43835]	[-1.79730]
R-squared	0.288522	0.475746	0.705838	0.674147
Adj. R-squared	0.090889	0.330120	0.624127	0.583632
Sum sq. resids	62.73292	0.001940	0.011651	86.83825
S.E. equation	1.866859	0.010383	0.025442	2.196440
F-statistic	1.459887	3.266902	8.638175	7.447912
Log likelihood	-45.58451	79.02054	57.51042	-49.48644
Akaike AIC	4.298709	-6.085045	-4.292535	4.623870
Schwarz SC	4.593223	-5.790532	-3.998022	4.918384
Mean dependent	-0.792763	-0.002207	-0.007286	-2.322222

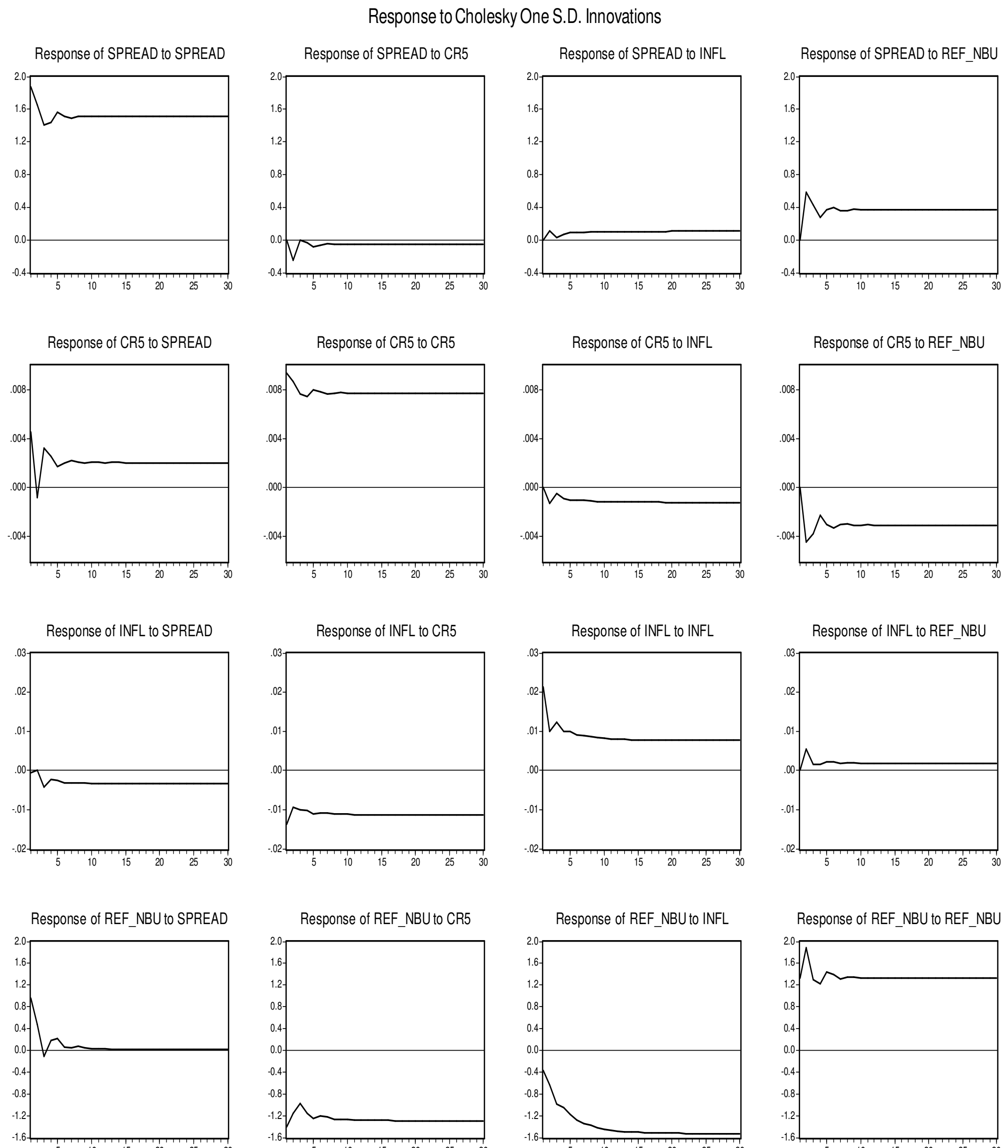
S.D. dependent	1.957956	0.012686	0.041498	3.403929
Determinant Residual Covariance		2.46E-07		
Log Likelihood		60.19727		
Log Likelihood (d.f. adjusted)		46.38853		
Akaike Information Criteria		-1.532378		
Schwarz Criteria		-0.157982		

APPENDIX E. Impulse response functions from VECM

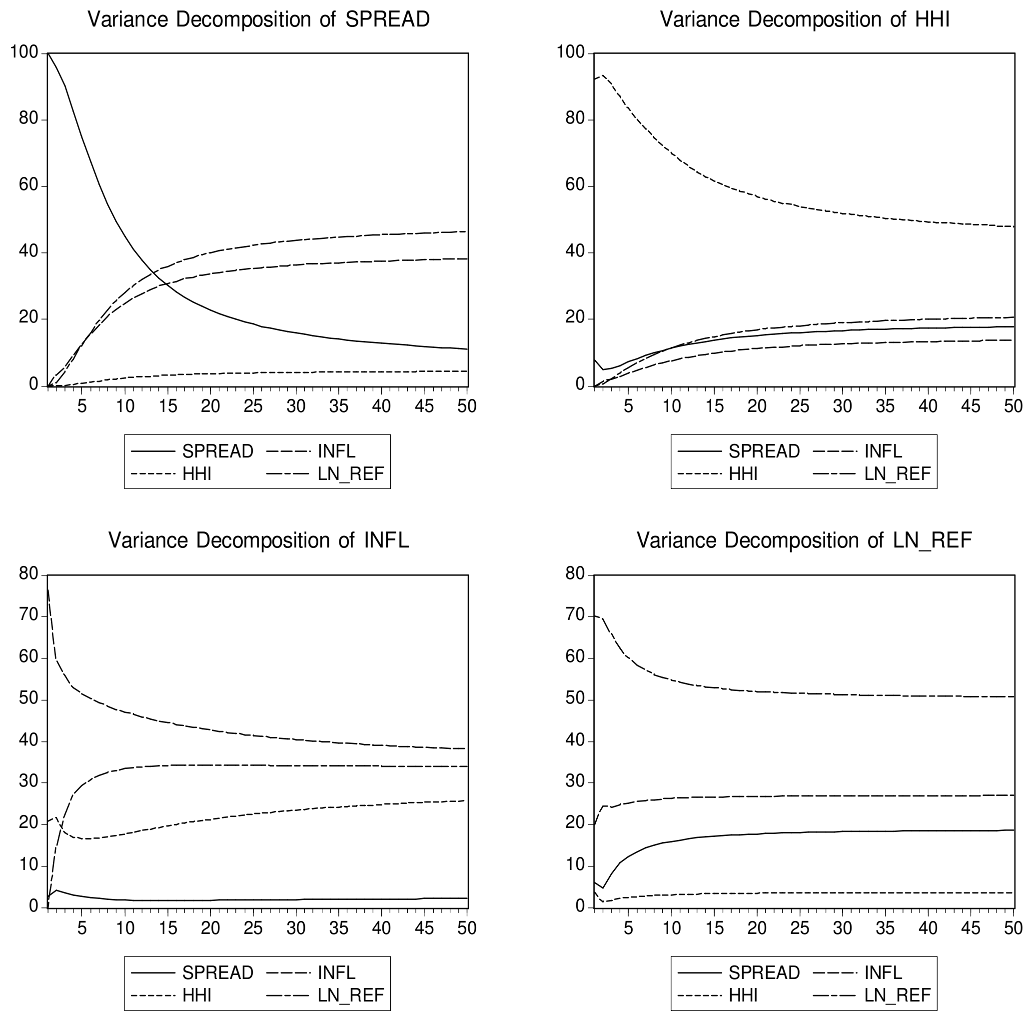


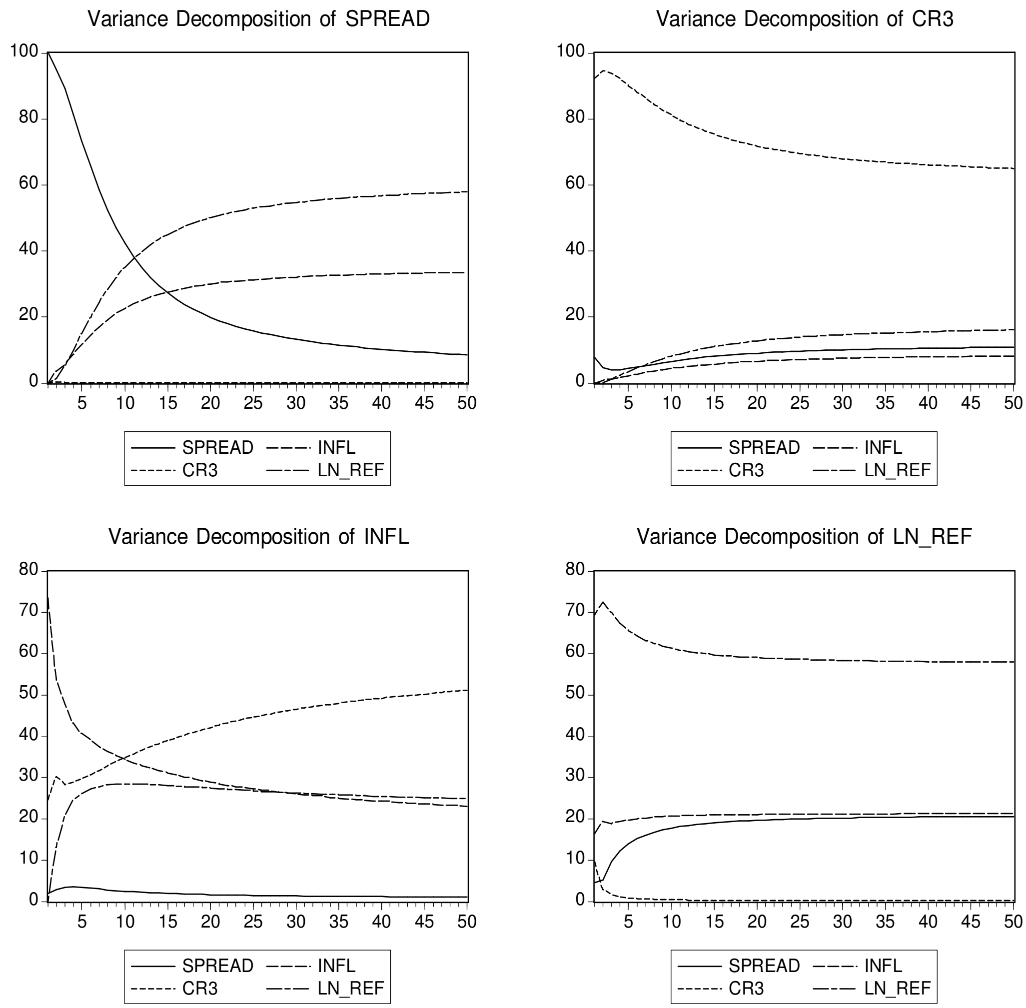


Response to Cholesky One S.D. Innovations
Response of SPREAD to SPREAD
Response of SPREAD to CR3
Response of SPREAD to INFL
Response of SPREAD to REF_NBU
Response of CR3 to SPREAD
Response of CR3 to CR3
Response of CR3 to INFL
Response of CR3 to REF_NBU
Response of INFL to SPREAD
Response of INFL to CR3
Response of INFL to INFL
Response of INFL to REF_NBU
Response of REF_NBU to SPREAD
Response of REF_NBU to CR3
Response of REF_NBU to INFL
Response of REF_NBU to REF_NBU


Response to Cholesky One S.D. Innovations
Response of SPREAD to SPREAD
Response of SPREAD to CR5
Response of SPREAD to INFL
Response of SPREAD to REF_NBU
Response of CR5 to SPREAD
Response of CR5 to CR5
Response of CR5 to INFL
Response of CR5 to REF_NBU
Response of INFL to SPREAD
Response of INFL to CR5
Response of INFL to INFL
Response of INFL to REF_NBU
Response of REF_NBU to SPREAD
Response of REF_NBU to CR5
Response of REF_NBU to INFL
Response of REF_NBU to REF_NBU

APPENDIX F. Variance decomposition




Variance Decomposition of SPREAD
Variance Decomposition of CR3
Variance Decomposition of INFL
Variance Decomposition of LN_REF
SPREAD
INFL
CR3
LN_REF
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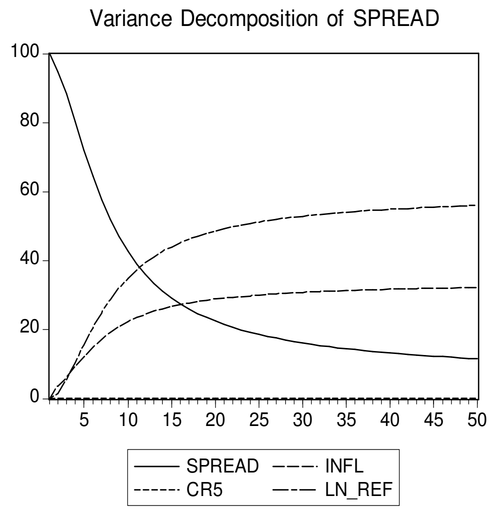
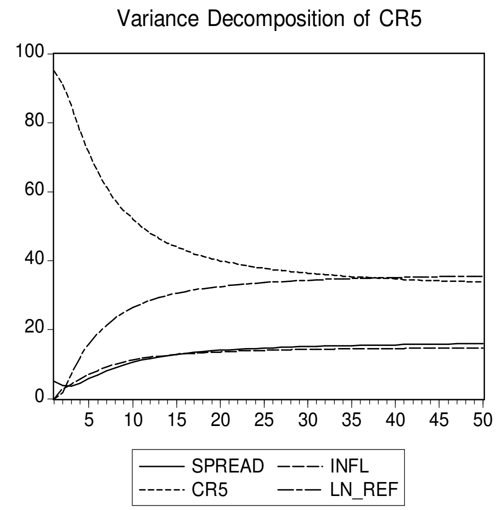
30
40
50
60
70
80
100
5
15
25
35
45


Variance Decomposition of SPREAD
100
80
60
40
20
0
5 10 15 20 25 30 35 40 45 50
SPREAD
INFL
CR5
LN_REF


Variance Decomposition of CR5
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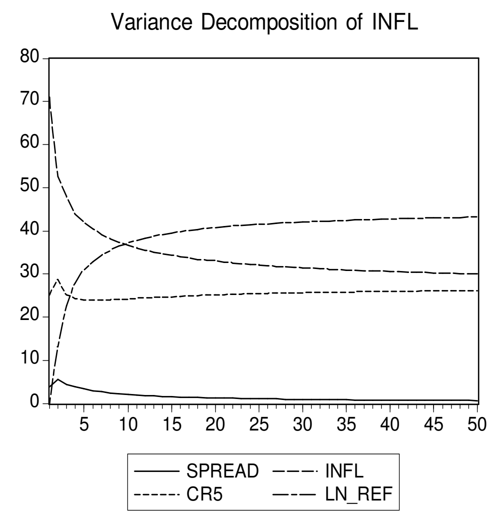
80
60
40
20
0
5 10 15 20 25 30 35 40 45 50
SPREAD
INFL
CR5
LN_REF


Variance Decomposition of INFL
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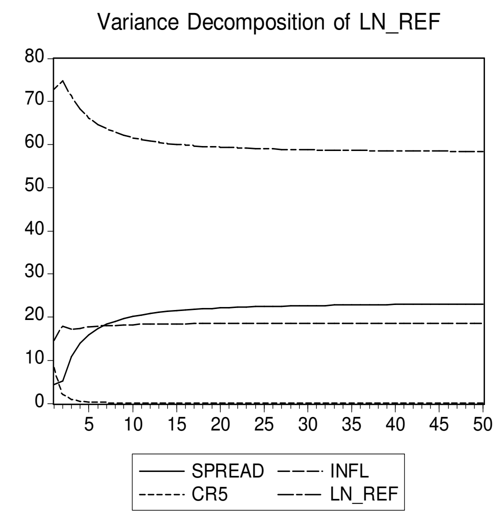
70
60
50
40
30
20
10
0
5 10 15 20 25 30 35 40 45 50
SPREAD
INFL
CR5
LN_REF


Variance Decomposition of LN_REF
80
70
60
50
40
30
20
10
0
5 10 15 20 25 30 35 40 45 50
SPREAD
INFL
CR5
LN_REF

APPENDIX G. Heteroscedasticity tests on cross-section data

1. Estimated equation for spread

White Heteroskedasticity Test:

F-statistic	2.496436	Probability	0.008639
Obs*R-squared	22.87642	Probability	0.011212

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Sample: 1 154
Included observations: 153
Excluded observations: 1
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007217	0.003170	2.276228	0.0243
SH_LOAN_DEP	-0.139530	0.058039	-2.404077	0.0175
SH_LOAN_DEP^2	1.538851	0.700072	2.198133	0.0296
INTERBANK	0.011969	0.009928	1.205649	0.2300
INTERBANK^2	-0.014524	0.016826	-0.863169	0.3895
FS	-0.000379	0.000450	-0.842213	0.4011
FS^2	1.13E-06	1.40E-06	0.805451	0.4219
TERM	-0.018935	0.011670	-1.622600	0.1069
TERM^2	0.013607	0.010644	1.278319	0.2032
EQ	-3.29E-06	3.43E-06	-0.958792	0.3393
EQ^2	2.86E-09	4.28E-09	0.667667	0.5054

R-squared	0.149519	Mean dependent var	0.001981
Adjusted R-squared	0.089626	S.D. dependent var	0.005679
S.E. of regression	0.005419	Akaike info criterion	-7.528695
Sum squared resid	0.004170	Schwarz criterion	-7.310820
Log likelihood	586.9452	F-statistic	2.496436
Durbin-Watson stat	1.965611	Prob(F-statistic)	0.008639

2. Estimated equation for overhead costs

White Heteroskedasticity Test:

F-statistic	0.610008	Probability	0.656053
Obs*R-squared	2.481279	Probability	0.647991

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Sample: 1 154
Included observations: 154

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003210	0.004974	0.645267	0.5197
1/SH_ASSETS	-2.96E-06	6.77E-06	-0.436908	0.6628
(1/SH_ASSETS)^2	9.70E-10	1.90E-09	0.509915	0.6109
SH_CAP	0.071334	0.062263	1.145684	0.2538
SH_CAP^2	-0.087635	0.146304	-0.598991	0.5501

R-squared	0.016112	Mean dependent var	0.006663
Adjusted R-squared	-0.010301	S.D. dependent var	0.026584
S.E. of regression	0.026721	Akaike info criterion	-4.374811
Sum squared resid	0.106387	Schwarz criterion	-4.276209
Log likelihood	341.8605	F-statistic	0.610008
Durbin-Watson stat	2.020574	Prob(F-statistic)	0.656053

APPENDIX H. Bank-specific factors influencing interest margin

Dependent Variable: MARGIN
Method: Least Squares
Sample: 1 154
Included observations: 153
Excluded observations: 1
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SH_LOAN_DEP	-0.512683	0.143356	-3.576283	0.0005
INTERBANK	-0.075318	0.027929	-2.696761	0.0078
FS	3.12E-05	4.17E-05	0.749573	0.4547
TERM	-0.093236	0.021860	-4.265106	0.0000
EQ	-2.99E-06	1.83E-05	-0.163471	0.8704
C	0.125750	0.012675	9.920971	0.0000

R-squared	0.295622	Mean dependent var	0.067767
Adjusted R-squared	0.271663	S.D. dependent var	0.053203
S.E. of regression	0.045405	Akaike info criterion	-3.307970
Sum squared resid	0.303055	Schwarz criterion	-3.189129
Log likelihood	259.0597	F-statistic	12.33892
Durbin-Watson stat	2.137580	Prob(F-statistic)	0.000000

APPENDIX I. Bank-specific factors influencing overhead costs

Dependent Variable: OC
Method: Least Squares
Date: 05/22/05 Time: 17:49
Sample: 1 154
Included observations: 154

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1/SH_ASSETS	2.20E-05	8.36E-06	2.626843	0.0095
SH_CAP	-0.021718	0.080342	-0.270318	0.7873
C	0.065963	0.010622	6.209938	0.0000

R-squared	0.043758	Mean dependent var	0.080684
Adjusted R-squared	0.031092	S.D. dependent var	0.083744
S.E. of regression	0.082432	Akaike info criterion	-2.134399
Sum squared resid	1.026049	Schwarz criterion	-2.075238
Log likelihood	167.3487	F-statistic	3.454885
Durbin-Watson stat	2.098012	Prob(F-statistic)	0.034110