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Chapter Author: Chung-Shu Wu, Sheng-Cheng Hu

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Interest Rates, Credit Rationing, and Banking Deregulation in Taiwan

Chung-Shu Wu and Sheng-Cheng Hu

8.1 Introduction

Taiwanese financial markets are segmented into an official sector and an unofficial sector. Since the early 1980s, the government has undertaken gradual financial liberalization, leading to an expansion of the official sector. The purpose of this paper is to study the effect of financial liberalization, especially banking deregulation, on the behavior of interest rates.

The official (or formal) financial sector consists of domestic banks and other financial institutions, most of which are either government owned or semigovernment institutions.[1] The official sector also includes local branches of foreign banks (local foreign banks hereafter), whose assets accounted for 7.8 percent of all bank assets in 1987 and 5.5 percent in 1996. Domestic banks and local foreign banks are to some extent segmented. Local foreign banks serve primarily firms engaged in international trade. They rely on the money market rather than on deposits for their supply of funds because they are allowed to have only one branch in addition to their local headquarters.[2] Until the early 1980s, domestic

1. Examples of financial institutions are credit companies, credit departments of farmers' and fishermen's associations, investment and trust companies, postal remittance and savings banks, insurance companies, and bill and securities finance companies.

2. Foreign banks were allowed to open only a local headquarters but not branches before 1986. They have been allowed to open one branch in addition to their local headquarters since then.

banks benefited from restricted entry, but their operations and their free-
dom to set interest rates were highly regulated by the government. As a
result, they rationed credit by serving primarily large private and govern-
ment enterprises.

The unofficial (or informal) financial sector takes various forms. "Ros-
cas" (rotating savings and credit associations), *de-shia cheng chuangs* (i.e.,
underground money shops), postdated checks, unsecured loans from pri-
vate sources, and individual deposits with firms are but a few examples.[3]
According to Shea, Kuo, and Huang (1995), informal financing accounted
for 48 percent of total borrowing by private enterprises in 1964. This ratio
declined steadily to 27 percent in 1973 and then rose steadily back to 40
percent in 1980. The ratio fluctuated between 35 and 44 percent during
the next seven years before it began to fall from 40 percent in 1987 to 25
percent in 1992. Overall, during the period 1964–92, informal financing
accounted for slightly more than one-third of total borrowing by all pri-
vate enterprises (excluding borrowing from money and bond markets). A
survey conducted by the Central Bank of China (1996) shows that in 1995,
37 percent of borrowing by small and medium-size firms was from house-
holds and other businesses, compared with only 9 percent by large firms.

The informal financial sector also helps consumers overcome credit con-
straints. This can be illustrated by the fact that despite high housing prices,
the home ownership rate in Taiwan has been not only high and rising
(around 65 percent in 1980 and nearly 80 percent in 1991) but also quite
uniform across the board. Even for the age cohort 30 years or younger,
whose members are more likely to be credit constrained, the home owner-
ship rate is nearly 80 percent. Overall, no more than 30 percent of Taiwan-
ese consumers are credit constrained.[4] (See Chan and Hu 1997.)

Since the early 1980s, Taiwan has undertaken gradual liberalization of
its financial markets, including banking deregulation, foreign exchange
liberalization, establishment of the money market, and development of a
financial monitoring system. Banking deregulation measures include abol-
ishment of direct central bank control of bank interest rates, privatization
of state banks, liberalization of entry of private banks, and relaxation of
regulations with respect to bank business activities and the expansion of
branches by existing banks. For example, domestic banks were allowed to
open trust divisions and to trade securities beginning in 1987, and both

3. A rosca is essentially a mutual fund. Members of the rosca commit to putting a fixed
sum of money into a pot for each period of the life of the rosca. The pot is then allocated
to one of the members either randomly or through bidding. The next period, the process
repeats itself except that previous winners are excluded from receiving the pot. The process
continues until each member of the rosca has received the pot once. At this point, the rosca
either is disbanded or begins all over again. See Besley, Coate, and Loury 1993.

4. According to Jappalli and Pagano (1989), the percentage of consumers who are credit
constrained is 19 percent for the United States, 35 percent for Japan, and more than 50
percent for Italy, Spain, and Greece.

**Table 8.1   Important Developments in Taiwan's Financial Liberalization since the
Early 1980s**

1. *November 1980:* The central bank promulgated and implemented the Guideline on the
   Adjustment of Bank Interest Rates, which allowed banks to set their own interest rates
   on negotiable certificates of deposit and debentures as well as on bill discounts. The
   range between the regulated maximum and minimum lending rates was also expanded.
2. *1984:* Entry regulations governing the branches of existing domestic banks were relaxed
   by allowing each qualified bank to set up three full-service and three limited-service
   branches per year, as compared with two each earlier. Effective August 1992, this
   maximum number of new branches each bank is allowed to set up per year was further
   increased to five.
3. *March 1985:* The Interest Regulation Act was abolished. Under the new system, the
   range of lending rates was expanded. In addition, banks were allowed to set their own
   rates on foreign currencies.
4. *January 1986:* The central bank reduced the categories of deposit rate ceilings from
   thirteen to four in number, thus allowing banks to set their own rates for various kinds
   of deposits.
5. *20 July 1989:* The Banking Law was revised effectively. The revised law deleted the
   remaining regulations controlling maximum deposit rates and maximum and minimum
   loan rates.
6. *1991 and 1992:* Sixteen new private banks were granted charters and began operation,
   and Chinatrust was converted from an investment and trust company to a commercial
   bank.
7. *May 1992:* The Ministry of Finance allowed banks to enter the secondary market to act
   as dealers and brokers. Before that time, there were only three bill finance companies in
   the money market.

Note: For more detailed information, see Shea (1992).

domestic and foreign banks were allowed to trade securities and to enter
the credit card business beginning in 1988. Foreign banks have also been
given more freedom to do business, including setting up a branch in addi-
tion to the local headquarters (see n. 2, above). Table 8.1 provides the key
dates on which deregulation measures took effect. The government is now
embarking on an ambitious plan to turn Taiwan into a regional operation
center. The plan calls for the overhaul of the country's financial system
and further liberalization and internationalization of its financial markets.

Financial liberalization affects both the quantities of financial transac-
tions (loans and deposits) and prices (interest rates) in each sector by pro-
moting competition, reducing the costs of financial transactions, and in-
fluencing the risk-taking behavior of financial institutions. While there
have been debates about the welfare effects of Taiwan's financial deregula-
tion (see Shea 1992), the purpose of this paper is to investigate whether
financial liberalization has succeeded. We shall focus our attention on
banking deregulation. We choose to study the price, rather than the quan-
tity, effect of deregulation because only by studying the behavior of inter-
est rates are we able to determine whether banking deregulation reduces
market segmentation. Specifically, we shall study the effect of deregulation

on the spreads between bank lending and deposit rates and the differential between official and black market interest rates.

The paper is organized as follows. Section 8.2 briefly describes our analytical framework. Section 8.3 provides the empirical results. Section 8.4 summarizes our main findings.

8.2   Analytical Framework

For analytical purposes, we can think of the banking industry as segmented between an official sector (o) and an unofficial sector (u). The unofficial banking sector is competitive. Entry into the official sector is prohibited; thus existing banks enjoy oligopoly power. In each sector $j =$ o,u, the lending rate is given by

$$(1) \qquad\qquad r_\ell^j = r + \rho_\ell^j + \tau_\ell^j,$$

where ρ_ℓ^j is the risk premium to cover the default risk of borrowers and τ_ℓ^j is the transactions cost of handling loans plus the possible oligopoly rents for banks in the official sector that enjoy oligopoly power. The deposit rate r_d^j is given by

$$(2) \qquad\qquad r_d^j = r + \rho_d^j - \tau_d^j,$$

where r is the risk-free rate, ρ_d^j is the risk premium (due to the default risk of the depository institutions), and τ_d^j is the transactions cost for handling small deposits plus oligopoly rents for banks if the sector is oligopolistic. In the official sector, since depository institutions are either government owned, or semigovernmental institutions, or local branches of reputable foreign banks, we can take $\rho_d^j = 0$.

From the above two equations, we obtain the spread between the loan and deposit rates:

$$(3) \qquad\qquad r_\ell^j - r_d^j = \rho^j + \tau^j,$$

where $\tau^j = \tau_d^j + \tau_\ell^j$, and $\rho^j = \rho_d^j - \rho_\ell^j$ are, respectively, the total transactions cost plus oligopoly rents and the risk premium.

If the official sector were competitive and fully integrated with the unofficial sector and there were no entry barriers, one would expect interest rates for each risk class, and thus average interest rates, to be equalized between the two sectors. The equalization of interest rates across sectors implies that the differential between unofficial (black market) and official interest rates is stationary and therefore that there are no long-term or short-term opportunities for arbitrage. Furthermore, information about interest rates in one market is useful in explaining interest rates in the other market.

In Taiwan, the two sectors are segmented. The official sector is regulated

and the government sets an *upper* limit on lending rates; thus official lending institutions ration credit by making mainly low-risk loans (loans to large firms), leaving high-risk loans (loans to small and medium-size firms) to the unofficial sector. As a result, the average (lending) interest rate is higher in the unofficial sector than in the official sector, reflecting the differences in risk premiums as well as transactions costs and oligopoly rents in the two sectors.

The effects of banking deregulation are threefold. First is the (transactions) cost effect: the reduction or even elimination of red tape and restrictions on bank activities leads to a lower transactions cost. Second is the competition effect: the relaxation of barriers to new entry in the official sector reduces the oligopoly rents enjoyed by existing banks. Third is the risk-taking effect: the lifting of the maximum lending rates set by the government encourages risk taking by financial institutions in the official sector.

Equation (3) shows that the first two (cost and competition) effects lead to a lower lending rate and a narrower loan-deposit rate spread in the official sector. Whether the third (risk taking) effect increases the loan-deposit rate spread in the official sector depends on whether banks discriminate among their customers by risk. In the absence of discrimination, interest rate liberalization increases the fraction of riskier loans served by the official sector, leading to a rise in the (average) spread between the lending and deposit rates. If, however, banks do discriminate among their customers by risk, charging small and medium-size firms higher interest rates than they would large firms, the risk premium for each risk class remains unchanged. However, the "average" risk premium will appear to increase as a result of the interest rate liberalization that allows the banks to take riskier loans. Overall, banking deregulation lowers the "average" loan-deposit rate spread in the official sector if the competition and transactions cost effects dominate the risk-taking effect.

The competition and cost effects of banking deregulation cause a narrowing of the differential between unofficial and official interest rates. The risk-taking effect increases the interest rate differential if banks do not discriminate among customers by their risk or if we consider only average interest rates. Thus the overall effect of banking deregulation is to cause the convergence of the (average) interest rates of the two sectors depending on whether the risk-taking effect dominates the cost and competition effects. The official and unofficial rates need not converge. However, if the central bank sets interest rates and thereby causes credit rationing, or if banks have only limited freedom to deviate from the official rates, then interest rate liberalization tends to result in a lower interest rate differential.

Furthermore, if the two sectors are segmented and banks directly set interest rates, the official interest rate is unresponsive, while the unofficial interest rate is responsive, to market conditions. As a result, the interest

rate differential fluctuates according to market conditions. Banking deregulation, especially relaxation of interest rate regulation, leads to desegmentation of the two sectors and causes interest rates in the two sectors to respond to the same market conditions in the same manner. As a result, interest rate liberalization increases the variance in interest rates but reduces the variance in the interest rate differential.

The official sector can be further divided into the domestic (d) and foreign (f) segments. Local foreign banks are permitted by the government to engage in only limited banking activities, but they are less regulated in these permitted activities. Whether interest rate spreads are larger for local foreign banks than for domestic banks depends on how risk taking and efficient local foreign banks are. If their risk taking dominates their efficiency, then we expect the interest rate spread to be larger for foreign banks than for domestic banks. Banking deregulation increases the differential between the domestic and local foreign interest-rate spreads if the risk-taking effect dominates the competition and cost effects.

8.3   Empirical Results

As shown in table 8.1, since 1980 a number of important financial liberalization events have taken place, leading to increased competition among domestic banks and between domestic and local foreign banks. The most important event was perhaps the establishment of sixteen new private banks in 1992. As further illustrated in table 8.2, the number of branches of domestic banks increased drastically from 756 in 1991 to 897 in 1992. Since then more than one hundred new branches have been established each year, compared with approximately thirty per year before 1991. Therefore, it is natural to take 1991 as the break point of banking deregulation. Nevertheless, since we do not have monthly data on loan-deposit rate spreads before 1991, we will provide a comparison of the empirical results for the two periods only for the cases where data are available.

That banking deregulation reduces or eliminates the differential between official and unofficial interest rates means that the two interest rates should not drift apart following a shock. And there should be no long-term opportunity for arbitrage. In other words, the two interest rates should be cointegrated and should have a common trend.

In the following subsections, we will first illustrate the pattern of the spreads between loan and deposit rates and the differentials between black market and official interest rates. Next, we will provide unit root tests of whether there exist long-term profit opportunities due to interest rate differentials. Then we will use the causality test to examine the transmission of information across markets. Finally, we will further discuss the market linkage by looking into the impulse response functions among interest rate spreads.

Table 8.2   **Number of Depository Institutions (end of year)**

Year	Domestic Banks		Medium Business Banks		Local Branches of Foreign Banks		Credit Cooperatives		Credit Departments of Farmers' Associations		Credit Departments of Fishermen's Associations	
	H.O.	Bra.	H.O.	Bra.	H.O.	Bra.	H.O.	Bra.	H.O.	Bra.	H.O.	Bra.
1981	15	543	8	171	24	24	74	n.a.	280	n.a.	4	n.a.
1982	16	552	8	171	25	25	75	n.a.	280	n.a.	4	n.a.
1983	16	556	8	189	28	28	75	n.a.	282	n.a.	12	n.a.
1984	16	561	8	197	31	31	75	n.a.	282	n.a.	16	n.a.
1985	16	585	8	203	32	32	75	289	283	565	17	5
1986	16	601	8	212	32	32	75	303	284	593	19	10
1987	16	632	8	236	32	33	74	294	282	603	19	11
1988	16	663	8	240	32	35	74	308	282	614	22	13
1989	16	692	8	261	32	38	74	358	285	665	22	20
1990	16	721	8	275	32	43	74	399	285	713	24	31
1991	17	756	8	290	32	47	74	425	285	754	26	31
1992	32	897	8	315	32	50	74	439	285	770	27	33
1993	33	1,030	8	352	32	55	74	482	285	788	27	34
1994	34	1,174	8	403	32	57	74	530	285	827	27	38
1995	34	1,361	8	446	32	58	74	556	285	886	27	44
1996	34	1,464	8	472	32	65	74	595	285	925	27	47

Source: Central Bank of China, *Financial Statistics Monthly* (various issues).
Note: H.O. = head offices; Bra. = branches.

All the data on interest rates are provided by the Economic Research Department of the Central Bank of China and are available in the *Financial Statistics Monthly,* Taiwan District, Republic of China. The quarterly data are available from 1983:Q1 to 1996:Q4. The monthly data are available only from January 1991 to December 1996. The data on interest rates in unorganized money markets and commercial paper rates are available from August 1987 to December 1996.

The official lending (deposit) rate is taken to be the weighted average of interest rates on loans (deposits) offered by financial institutions, and the unofficial (black market) rate is taken to be the average interest rate on loans against postdated checks in unorganized money markets.[5] Because we wish to show the differences in the behavior patterns of domestic and local foreign banks, we differentiate the interest rates of domestic banks

5. Unofficial or black market interest rates are based on surveys of 213 companies in the three largest cities in Taiwan (Taipei, Kaoshiung, and Taichung) conducted by three commercial banks (First Commercial Bank, Hua-Nan Commercial Bank, and Chang-Hua Commercial Bank) concerning the interest rates the firms paid in unorganized money markets on loans against postdated checks, unsecured loans, and deposits by individuals with the firms. Here we take the black market interest rate as the mean of the interest rates on loans against postdated checks in the three cities.

from those of local foreign banks. Since firms borrow not only from the black market but from the money market as well, when we study the differential between unofficial and official interest rates, we use the thirty-day commercial paper rates in primary markets to represent the official interest rates.

8.3.1   Loan-Deposit Interest Rate Spreads and Black-Market–Money-Market Interest Rate Differentials

As mentioned above, two main factors contribute to the gaps between interest rates. First, increased competition and the decline in the transactions costs cause the spreads between loan and deposit rates to shrink. Second, the risk factor widens the interest rate spreads. Before we analyze the interest rate spreads, we plot in figures 8.1 and 8.2 loan rates, deposit rates, spreads between loan and deposit rates, and differentials between interest rates offered by domestic and by local foreign banks. We also provide the related data in tables 8.3 and 8.4. These graphs and tables show that there does exist a declining trend in the spreads between loan and deposit rates for both domestic and local foreign banks, suggesting that the competition and cost effects due to banking deregulation outweighed the increased risks undertaken by domestic and local foreign banks. Competition and a decline in transactions costs not only cut the spread between loan and deposit rates but also reduced the differential between loan rates and between deposit rates of domestic and local foreign banks.

All test statistics show a significant rejection of the null hypothesis that the mean spreads between interest rates on loans and on deposits and the mean differentials between loan rates and those between deposit rates of domestic and local foreign banks did not change in 1991.[6] Table 8.4 shows interestingly that the differential between black market and money market interest rates has been stable since 1987, though the loan-deposit rate spreads of domestic banks and those of local foreign banks have been declining since the 1980s. The test statistics also show that the means did not change significantly in December 1991. Because the number of new bank branches has increased drastically since the end of 1991, customers have been lured away from unorganized money markets. As a result, funds supplied in the black markets faced higher risks, and the risk premiums had to rise to compensate for the increased risk. This might be the reason why we find such a stable differential between black market and money market interest rates.

Another important fact stands out from the tables. The variances of

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6. Though the differences in interest rate spreads among domestic banks are relatively small compared to those for local foreign banks, small sample variance causes the test statistic to significantly reject the null hypothesis of equal means between the two periods.
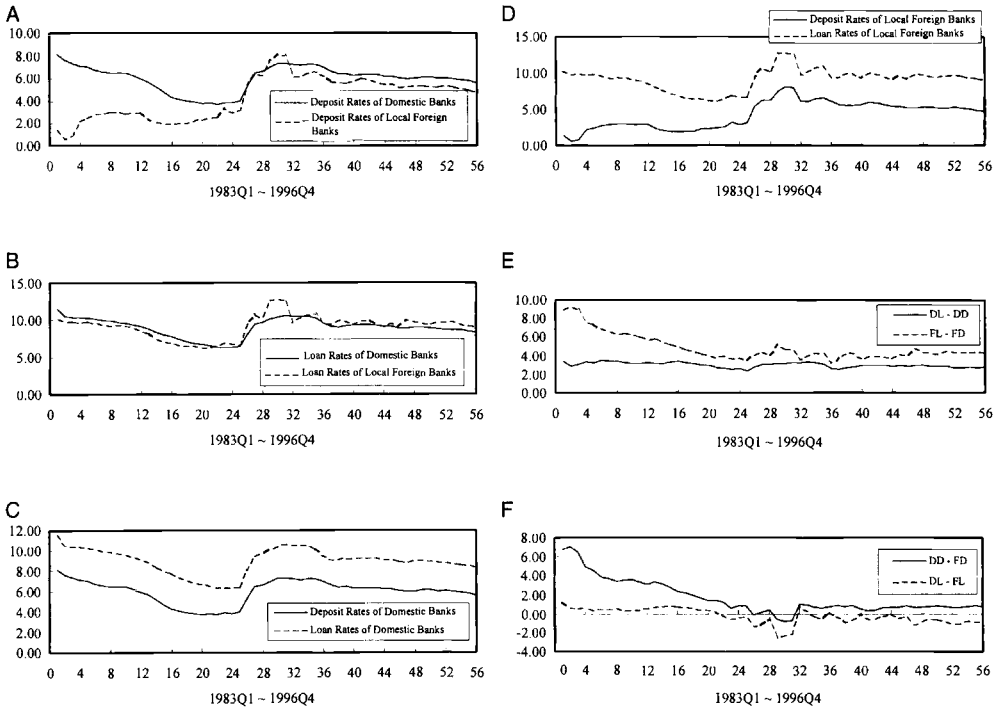
A

B

C

D

E

F

Fig. 8.1   Interest rates of domestic and local foreign banks, quarterly 1983:Q1–96:Q4

Note: *A,* Deposit rates of domestic and local foreign banks. *B,* Loan rates of domestic and local foreign banks. *C,* Deposit and loan rates of domestic banks. *D,* Deposit and loan rates of local foreign banks. *E,* Loan-deposit rate spreads of domestic and local foreign banks. *F,* Differentials between loan rates and between deposit rates of domestic and local foreign banks. See table 8.3 note for abbreviations.

interest rates, the variances of loan-deposit rate spreads, and the variances of interest rate differentials were all significantly larger before than after 1991. This suggests that the competition brought by the increased number of new private banks had a stabilizing effect on not only interest rates themselves but also interest rate spreads and differentials. The decreased volatility of interest rate spreads reduced the uncertainty over interest rates. As a consequence, the spreads between loan and deposit rates declined. On the other hand, although the volatility in the differential between black market and money market interest rates fell from the period July 1987–December 1991 to the period January 1992–December 1996, the increased lending risk surpassed the reduced uncertainty. This is why we find a stable differential between black market and money market interest rates through the period 1983–96.
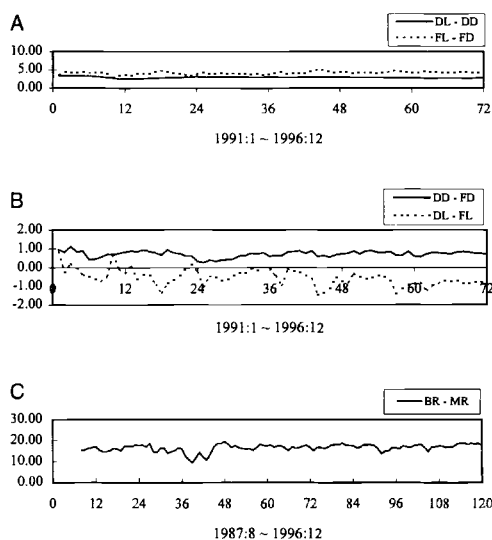
Fig. 8.2   Interest rate spreads and differentials for domestic and local foreign banks and for black markets and money markets, monthly 1987:8–96:12

Note: A, Loan-deposit rate spreads of domestic and local foreign banks. B, Differentials between loan rates and between deposit rates of domestic and local foreign banks. C, Differentials between black market and money market interest rates. BR = black market interest rate; MR = money market interest rate. See table 8.3 note for other abbreviations.

8.3.2   Stationarity of Interest Rate Spreads and Differentials

The preceding subsection showed that the magnitudes of interest rate spreads and differentials before 1991 were significantly different from those after 1991. Test statistics also support the argument that the means of interest rate spreads and differentials did change between the two periods. In this subsection, we will further provide the unit root test to ascertain if these interest rate spreads and differentials are stationary, that is, if we can rule out long-term profit opportunities for arbitrage. If two financial markets are linked, the spreads between loan and deposit rates in each market and the differentials between interest rates in the two markets should not rise persistently over a long period of time. That is, they should have the stationarity property. If interest rate spreads or differentials rise steadily, then they will eventually exceed any finite transactions costs and risk premiums. As a result, arbitrage can take place by lending high and borrowing low. In other words, the stationarity of interest rate spreads or differentials ensures that there is no long-term profit opportunity for arbitrage. (See Lin 1995.)

To check the stationarity of spreads and differentials, we test the hypothesis with three different unit root tests; they are Dickey-Fuller (1979), Phillips and Perron (1988), and Sims (1988). Test results are reported in

Table 8.3   **Deposit Rates, Loan Rates, and Interest Rate Spreads, Quarterly 1983:Q1–96:Q4**

Period	DL-DD	FL-FD	DD-FD	DL-FL	DD	DL	FD	FL
1983:Q1–85:Q4								
Mean	3.258	7.186	4.508	0.574	6.832	10.083	2.323	9.509
Variance	0.029	1.526	2.106	0.053	0.394	0.381	0.768	0.211
1986:Q1–88:Q4								
Mean	2.987	4.526	1.894	0.355	4.234	7.221	2.340	6.866
Variance	0.096	0.546	0.800	0.242	0.408	0.725	0.179	0.311
1989:Q1–91:Q4								
Mean	3.030	4.142	0.260	−0.852	6.639	9.669	6.379	10.521
Variance	0.093	0.294	0.453	1.149	1.006	1.575	1.655	2.930
1992:Q1–94:Q4								
Mean	2.888	4.059	0.668	−0.503	6.249	9.137	5.581	9.640
Variance	0.022	0.122	0.027	0.117	0.037	0.022	0.058	0.097
1995:Q1–96:Q4								
Mean	2.790	4.338	0.765	−0.783	5.924	8.714	5.159	9.496
Variance	0.004	0.010	0.003	0.030	0.034	0.049	0.035	0.044
1983:Q1–91:Q4								
Mean	3.089	5.284	2.221	0.026	5.902	8.991	3.681	8.965
Variance	0.082	2.628	4.204	0.858	2.005	2.483	4.562	3.527
1992:Q1–96:Q4								
Mean	2.849	4.171	0.707	−0.615	6.119	8.968	5.412	9.583
Variance	0.017	0.094	0.019	0.099	0.061	0.076	0.092	0.078
F-test[a]	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
T-test[b]	0.0001	0.0003	0.0001	0.0004	0.3753	0.9307	0.0000	0.0606

Note: DD = deposit rates of domestic banks; DL = loan rates of domestic banks; FD = deposit rates of local foreign banks; FL = loan rates of local foreign banks.

[a] F-test for the equality of variance for 1983:Q–91:Q4 and 1992:Q1–96:Q4. Table reports significance levels.

[b] T-test for the difference between two means for 1983:Q1–91:Q4 and 1992:Q1–96:Q4. Table reports significance levels.

table 8.5. As can be seen from the table, all test results show a significant rejection of the existence of unit roots for both periods. The main exceptions occurred in the period 1983–91, in which the Sims (1988) Bayesian test of the differential between domestic and foreign bank interest rates was unable to reject the null unit root hypothesis. In other words, most interest rate spreads and differentials followed a stationary process, and there did not exist a long-term profit opportunity during and after the period of banking deregulation. After banking deregulation, the segmentation between domestic and local foreign banks was not significant.

8.3.3   Cross-Market Causality in Interest Rate Spreads and Differentials

The causality test is often employed to examine the lead and lag relation between asset prices. Such a relation is frequently interpreted as the trans-

Table 8.4   **Black Market and Money Market Interest Rates, Monthly 1987:8–96:12**

Period	BR-CPR	BR	CPR
1987:8–89:7			
Mean	16.2663	21.8733	5.6071
Variance	1.4163	2.4559	3.7412
1989:8–91:7			
Mean	15.0946	24.2183	9.1238
Variance	7.8180	0.2699	8.1797
1991:8–93:7			
Mean	16.9054	24.2417	7.3363
Variance	0.7258	0.0802	1.0347
1993:8–95:7			
Mean	16.9788	23.9350	6.9563
Variance	1.3831	0.1145	1.2569
1995:8–96:12			
Mean	17.4959	23.7765	6.2806
Variance	1.0187	0.0538	1.1697
1987:8–91:12			
Mean	15.8126	23.1336	7.3209
Variance	4.6608	2.5544	7.7941
1992:1–96:12			
Mean	17.0873	24.0093	6.9220
Variance	1.0867	0.1263	1.3096
F-test	0.0000	0.0000	0.0000
T-test	0.0002	0.0003	0.3351

Note: BR = interest rates on loans against postdated checks in unorganized money markets (black market rates); CPR = commercial paper rates in primary market (money market rates).

mission of information across markets. (See, e.g., Engle, Ito, and Lin 1990; Lin, Engle, and Ito 1994.) In this study we will investigate whether interest rate spreads or differentials in one market (domestic banks' loan-deposit market or local foreign banks' loan-deposit market) can provide information useful in explaining spreads or differentials in another market. If two markets are linked, bidirectional, cross-market causality will be displayed.

In order to examine the causality relation between interest rate spreads or differentials, we use the procedure adopted by Caines, Keng, and Sethi (1981) and Liang, Chou, and Lin (1996). First, the order of the bivariate model is chosen to be the one giving minimal final prediction error. Then a stepwise causality test procedure is applied to determine the endogeneity and exogeneity of, or independence between, these two variables. At this stage, the unrestricted bivariate AR model and the restricted model excluding the cross-coefficients are estimated. The likelihood ratio tests are then performed to determine the direction of causality. (For details, see Caines et al. 1981.) Table 8.6 summarizes the empirical results obtained

Table 8.5   **Unit Root Tests**

Test[a]	DDL	DDD	FDL	DLL	DBM
	A. Quarterly 1983Q1–96Q4				
Period 1: 1983:Q1–91:Q4					
ADF(4)	−42.49**	−3.08**	−3.49**	−6.28**	
PP(4)	−9.62**	−0.09**	−2.75*	−9.59**	
SIMS	0.276	0.207	0.353	0.069	
Period 2: 1992:Q1–96:Q4					
ADF(4)	−6.79**	−8.48**	−12.78**	−14.31**	
PP(4)	−9.04**	−8.81**	−14.50**	−15.79**	
SIMS	0.033**	0.060*	0.007**	0.004**	
	B. Monthly 1991:1–96:12				
ADF(4)	−39.42**	−70.14**	−27.87**	−35.99**	−18.18**
PP(4)	−10.76**	−24.89**	−31.36**	−32.99**	−12.99**
SIMS	0.0897*	0.0014**	0.0002**	0.0000**	0.071*

Note: DDL = deposit-loan rate spreads of domestic banks; DDD = deposit rate differentials between domestic banks and local foreign banks; FDL = deposit-loan rate spreads of local foreign banks; DLL = loan rate differentials between domestic banks and local foreign banks; DBM = interest rate differentials between black markets and money markets.

[a]ADF(4) = augmented Dickey-Fuller (1979) unit root test with four lags. Their critical values are obtained from Dickey and Fuller (1979). PP(4) = Phillips-Perron (1988) unit root test with four lags. Their critical values are obtained from Dickey and Fuller (1979). SIMS = Sims (1988) Bayesian unit root test. Numbers in table are significance levels.

*Rejection of unit root null at the 10 percent level.

**Rejection of unit root null at the 5 percent level.

from quarterly data in panel A. As can be seen, during the period 1983: Q1–91:Q4 causality with respect to interest rate spreads ran from local foreign banks to domestic banks, but not the other way around. However, during the period 1992:Q1–96:Q4, there existed no causality relation between the two spreads. This result is also confirmed by the tests using monthly data in panel B. Panels C and D show the causality relations between the loan-deposit rate spreads of domestic and local foreign banks, respectively, and the differentials between black market and money market rates. We see that the causality runs from loan-deposit rate spreads of domestic banks to differentials between black market and money market interest rates, but not the other way around. On the other hand, loan-deposit rate spreads of local foreign banks and differentials between black market and money market interest rates have an interdependent relationship; that is, they cause each other.

Since the early 1970s the authorities in Taiwan have adopted a strategy of "planned gradualism" to liberalize step by step the control of interest rates. The revised Banking Law became effective on 20 July 1989. It practically closed the history of interest rate control in Taiwan. In principle, interest rates on loans, deposits, and other financial instruments are now determined by market forces. However, until 1991, most domestic banks

Table 8.6   **Causality Tests**

Test	χ^2 Test Statistic[a]	Significance Level	Conclusion
A. Between Domestic Banks' and Local Foreign Banks' Loan-Deposit Rate Spreads, Quarterly 1983:Q1–96:Q4			
Period 1: 1983:Q1–91:Q4			
T_{10}	(4) 11.058	0.026	$H_0 \gtrsim H_1$
T_{20}	(2) 0.851	0.653	$H_3 \gtrsim H_0$
T_{30}	(2) 10.386	0.006	$H_0 \gtrsim H_2$
T_{12}	(2) 10.207	0.006	$H_3 \gtrsim H_1$
T_{13}	(2) 0.672	0.715	$H_1 \gtrsim H_2$
Period 2: 1992:Q1–96:Q4			
T_{10}	(2) 1.311	0.519	$H_1 \gtrsim H_0$
T_{20}	(1) 0.693	0.405	$H_3 \gtrsim H_0$
T_{30}	(1) 0.463	0.496	$H_2 \gtrsim H_0$
T_{12}	(1) 0.619	0.432	$H_1 \gtrsim H_3$
T_{13}	(1) 0.848	0.357	$H_1 \gtrsim H_2$
B. Between Domestic Banks' and Local Foreign Banks' Loan-Deposit Rate Spreads, Monthly 1991:1–96:12			
T_{10}	(14) 14.399	0.420	$H_1 \gtrsim H_0$
T_{20}	(7) 10.292	0.173	$H_3 \gtrsim H_0$
T_{30}	(7) 4.098	0.768	$H_2 \gtrsim H_0$
T_{12}	(7) 4.106	0.767	$H_1 \gtrsim H_3$
T_{13}	(7) 10.301	0.172	$H_1 \gtrsim H_2$
C. Between Domestic Banks' Loan-Deposit Rate Spread and Black-Market–Commercial-Paper Rate Difference, Monthly 1991:1–96:12			
T_{10}	(4) 10.734	0.0297	$H_0 \gtrsim H_1$
T_{20}	(2) 3.050	0.218	$H_3 \gtrsim H_0$
T_{30}	(2) 7.683	0.021	$H_0 \gtrsim H_2$
T_{12}	(2) 7.685	0.021	$H_3 \gtrsim H_1$
T_{13}	(2) 3.051	0.217	$H_1 \gtrsim H_2$
D. Between Local Foreign Banks' Loan-Deposit Rate Spread and Black-Market–Money-Market Interest Rate Difference, Monthly 1991:1–96:12			
T_{10}	(4) 13.239	0.001	$H_0 \gtrsim H_1$
T_{20}	(2) 3.817	0.011	$H_0 \gtrsim H_3$
T_{30}	(2) 6.363	0.012	$H_0 \gtrsim H_2$
T_{12}	(2) 9.422	0.002	$H_3 \gtrsim H_1$
T_{13}	(2) 6.876	0.009	$H_2 \gtrsim H_1$

Note: An unrestricted model (of order k) is a model of the form

$$\begin{bmatrix} \psi_{11}(2) & \psi_{12}(2) \\ \psi_{21}(2) & \psi_{22}(2) \end{bmatrix} \begin{bmatrix} x_t \\ y_t \end{bmatrix} = \eta_t ,$$

where the orthogonal process η_t has covariance Σ and the orders of all polynomial entries of $\psi(z)$ not specified to be identically zero are of order k.

Table 8.6   (continued)

Hypotheses are as follows:

$$H_0 : \begin{pmatrix} \psi_{11} & \psi_{12} \\ \psi_{21} & \psi_{22} \end{pmatrix}, \quad H_1 : \begin{pmatrix} \psi_{11} & 0 \\ 0 & \psi_{22} \end{pmatrix}, \quad H_2 : \begin{pmatrix} \psi_{11} & \psi_{12} \\ 0 & \psi_{22} \end{pmatrix}, \quad H_3 : \begin{pmatrix} \psi_{11} & 0 \\ \psi_{21} & \psi_{22} \end{pmatrix}.$$

Tests are as follows:

T_{10}: H_1 is the null hypothesis and H_0 is the alternative hypothesis,
T_{20}: H_3 is the null hypothesis and H_0 is the alternative hypothesis,
T_{30}: H_2 is the null hypothesis and H_0 is the alternative hypothesis,
T_{12}: H_1 is the null hypothesis and H_2 is the alternative hypothesis,
T_{13}: H_1 is the null hypothesis and H_3 is the alternative hypothesis.

[a]Numbers in parentheses are lag orders.

were government owned. Their most important competitors were the more efficient local foreign banks. This might be the reason why we find a causal direction from the spreads of local foreign banks to those of domestic banks. Since 1991, when there was large-scale entry of private banks, government-owned banks have faced competition from all directions. At the same time, local foreign banks, which are under fewer regulations, have greater flexibility, experience, and efficiency. Their customers are mainly export and import firms with good track records. To lower the managing costs, local foreign banks raise funds from the money market rather than from time deposits. In other words, the markets served by domestic and local foreign banks have a certain degree of segmentation. This might explain the empirically weak connection between the two markets in the period 1992–96. Furthermore, by comparing the causal relations among the loan-deposit rate spreads of domestic banks and those of local foreign banks and the differentials between black market and money market interest rates, we find that domestic banks seem isolated from local foreign banks and black markets. This result might reflect the fact that though interest rates have been liberalized, most major domestic banks are still easily influenced by the central bank. Burdened with a long history, the way they run their businesses is still rather inflexible and inefficient compared with local foreign banks and black markets.

8.3.4   Impulse Response Functions

An impulse response function traces the dynamic effects of a shock on an economic or financial variable. Researchers are interested in finding whether there are short-term profit opportunities that investors can exploit by using simple trading strategies based on past information. However, because of the existence of different risk premiums and market friction, unpredictability is too restrictive in most empirical studies. The impulse response function is an alternative way to measure market linkage. Figures 8.3*A* and 8.3*B* plot the impulse response functions of the loan-deposit rate spreads of domestic and local foreign banks with respect
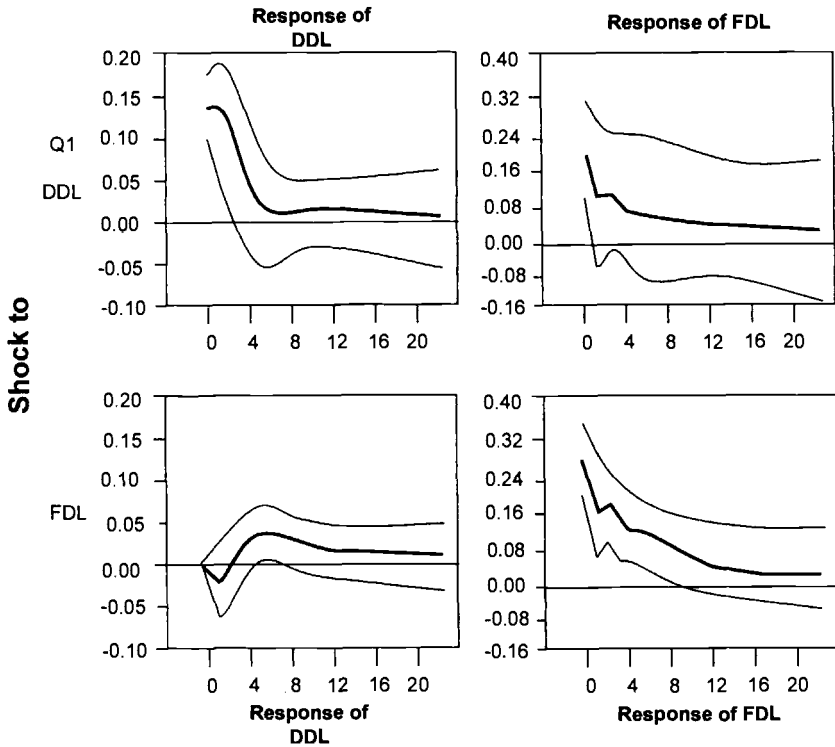
Fig. 8.3A   Impulse response curves for loan-deposit rate spreads of domestic and local foreign banks, quarterly 1983:Q1–91:Q4

Note: See table 8.5 note for abbreviations.

to a one-unit shock to the respective spreads, and their two-standard-error confidence intervals. For comparison, figure 8.3*C* provides impulse response functions for the differentials between loan and deposit rates of domestic and local foreign banks and the differentials between black market and money market interest rates. Figure 8.3*A* shows that before 1991, the interest rate spreads of domestic banks responded significantly only to shocks to the spreads of local foreign banks. After 1991, the responses were insignificantly different from zero (fig. 8.3*B*). The interest rate spreads of local foreign banks also displayed the same pattern; that is, the responses of interest rate spreads of local foreign banks to shocks in the spreads of domestic banks were significant before 1991, but not afterward. These findings are also confirmed by the monthly data in figure 8.3*C.* They suggest that there exists a weak linkage between interest rate spreads of domestic banks and local foreign banks because of the emergence of huge private banks and the customer segmentation between domestic and local foreign banks. The finding of a weak connection between interest rate
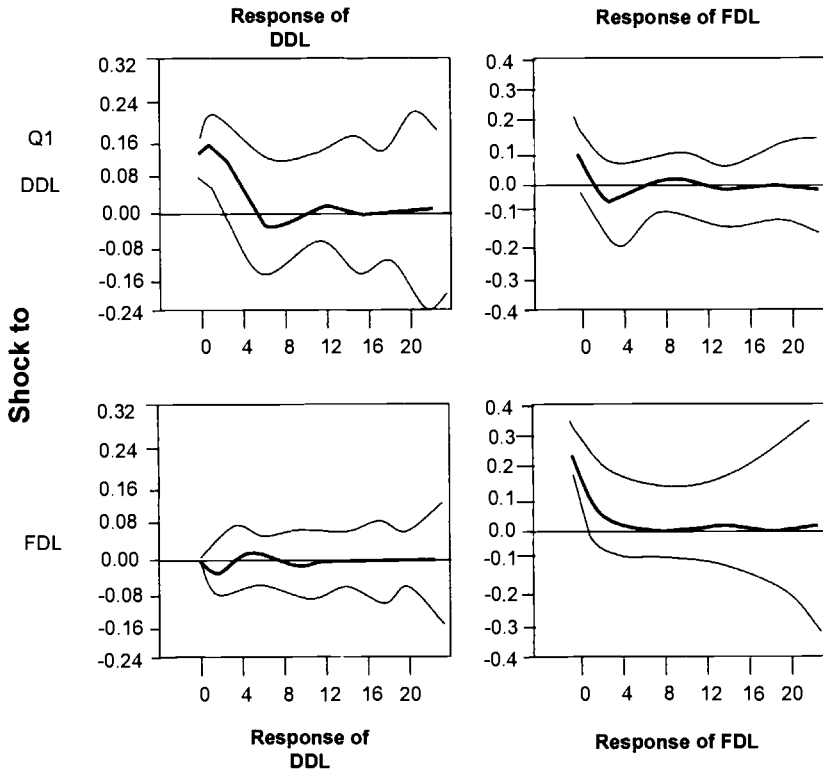
Fig. 8.3B   Impulse response curves for loan-deposit rate spreads of domestic and local foreign banks, quarterly 1991:Q1–96:Q4
Note: See table 8.5 note for abbreviations.

spreads after the banking deregulation is not unique to this study. By comparing Gensaki-Euroyen yield spreads and the difference between Euroyen and Gensaki interest rates, Lin (1995) also found a similar result.

8.4   Concluding Remarks

Our findings can be summarized as follows:

1. Deposit and lending rates of domestic banks and of local foreign banks and black market and money market interest rates experienced greater fluctuations before December 1991 than after.

2. Loan-deposit rate spreads of domestic banks and those of local foreign banks, as well as differentials between lending rates and between deposit rates of domestic banks and local foreign banks all were larger before December 1991 than afterward. Thus banking deregulation and the
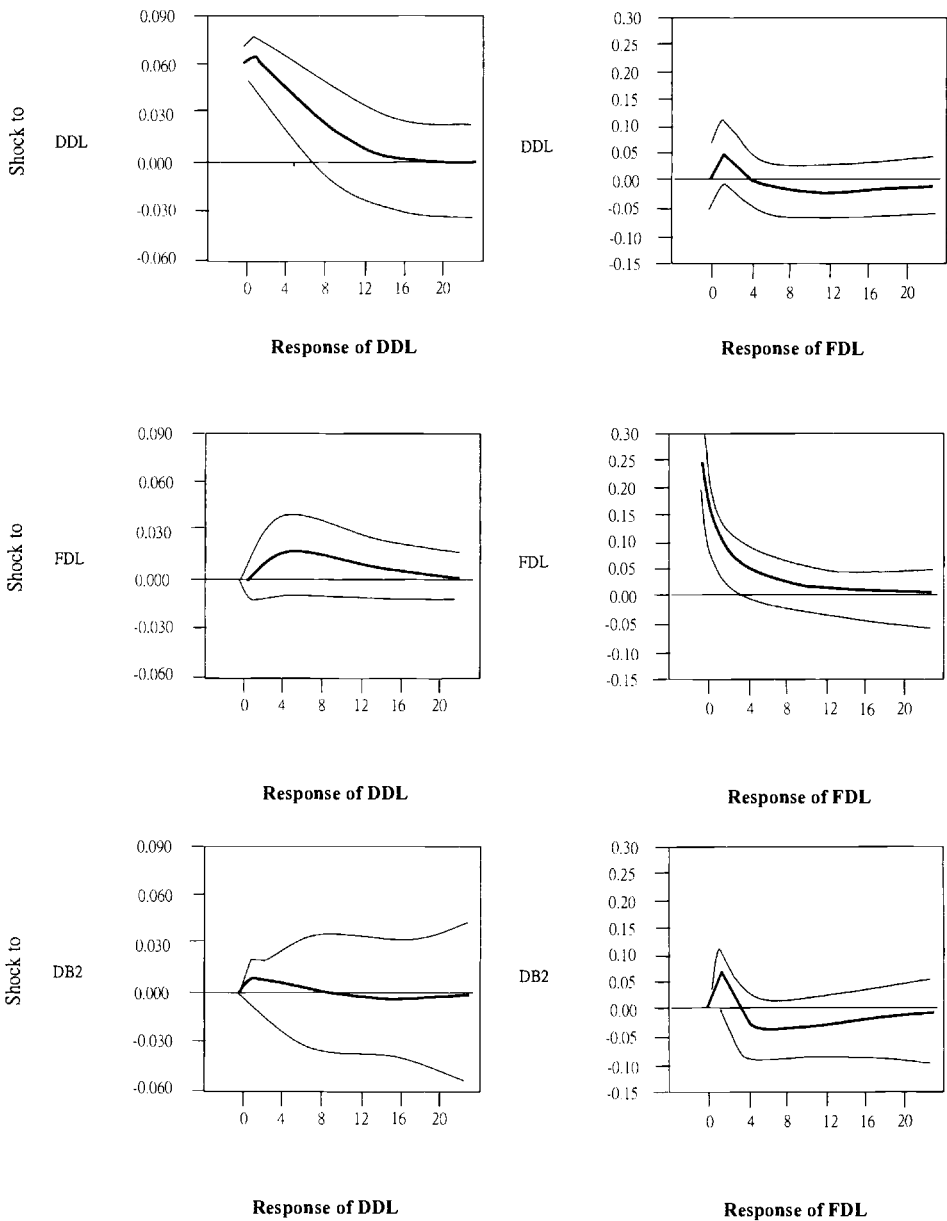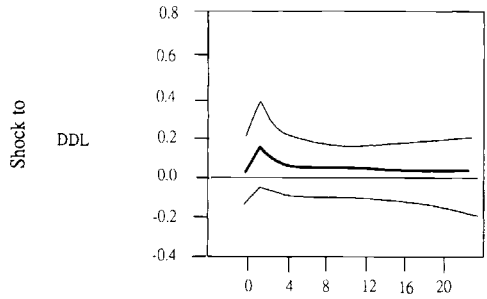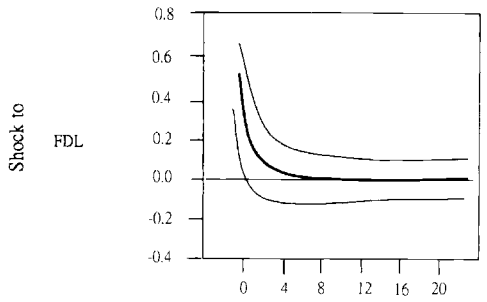
Fig. 8.3C   Impulse response curves for loan-deposit rate spreads of domestic and
local foreign banks and differentials between black market and money market
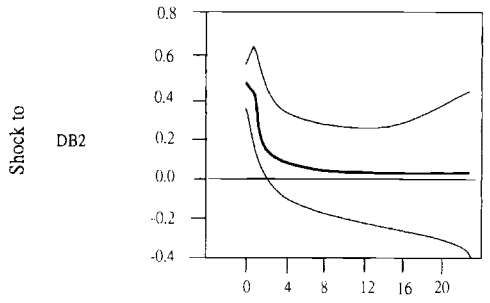interest rates, monthly 1991:1–96:12

Note: DB2 = interest rate differentials between black markets and money markets. See table
8.5 note for other abbreviations.

Shock to **DDL**

Response of DB2

Shock to **FDL**

Response of DB2

Shock to **DB2**

Response of DB2

Fig. 8.3C (continued)

accompanying sharp increase in the entry of private banks have substantially increased competition among banks, forcing a decline in the loan-deposit rate spread and the differential between interest rates in different sectors.

3. The differential between black market and money market interest rates experienced greater fluctuations before December 1991 than afterward. But the differential did not shrink in the second period despite a decline in its fluctuations. This indicates that the risk-taking effect dominates the competition effect because new banks absorbed funds from the black market and thus face higher risk premiums than government-owned banks do.

4. Most interest rate spreads and differentials followed a stationary process; therefore there did not exist a long-term profit opportunity during and after the period of banking deregulation.

5. During the period 1983:Q1–91:Q4 causality ran from loan-deposit rate spreads of local foreign banks to spreads of domestic banks, but not the other way around. Nevertheless, during the period 1992:Q1–96:Q4, there existed no causal relation between the two spreads. On the other hand, during the second period, loan-deposit rate spreads of local foreign banks and interest rate differentials between black markets and money markets were interdependent.

6. Before 1991, loan-deposit rate spreads of domestic banks responded significantly only to shocks to the spreads of local foreign banks. After 1991, the responses were insignificantly different from zero. Interest rate spreads of local foreign banks also displayed the same behavioral pattern.

In sum, we have found some evidence that banking deregulation may have encouraged competition and reduced costs of financial transactions and may have reduced segmentation of the banking industry. In this sense, banking deregulation in Taiwan is to some extent working.

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Comment   Shinji Takagi

Here Wu and Hu discuss the impact of banking deregulation (i.e., the easing of lending rate ceilings and entry restrictions) on (1) the margin between the deposit rate and the lending rate and (2) the segmentation of the banking sector in Taiwan. The paper should be considered more of an exercise in fact finding than in hypothesis testing because, as it turns out, the quantitative impact of banking deregulation cannot be determined a priori. In this sense, the conclusion that deregulation reduced the interest margin but did not reduce the difference between black market and official market lending rates may not be generalized as a necessary outcome of bank deregulation.

The margin between the deposit rate and the lending rate is influenced by many factors, some of which may well offset each other, including the price of financial intermediation, excess profits, and macroeconomic conditions. The authors recognize that the margin is affected in opposite directions by what they call the risk-taking factor (associated with the incor-

Shinji Takagi is professor of economics at the University of Osaka.

poration of riskier borrowers into the formal sector) and the competition effect (associated with the establishment of new banks and the privatization of existing banks). In finding that the margin did decline during recent years, the authors conclude that the competition effect must have dominated. But the margin is influenced by other factors, notably macroeconomic conditions, so that their conclusion remains only tentative.

The second component of the paper is potentially more interesting because market segmentation is a phenomenon observed in many developing countries. Whether or not bank deregulation helps to integrate the black market into the official market is indeed an interesting topic. Here the authors' assumption is that full liberalization will eliminate market segmentation altogether. On the basis of this assumption they argue that although the participation of riskier borrowers in the official market increases the official market lending rate and the presence of residual high-risk borrowers in the black market also increases the black market lending rate, the increase in the former rate must necessarily be larger than the increase in the latter. Otherwise, the average lending rates in the two markets would never converge.

The problem is that some people in the black market may never be included in the official market. In Japan, there are many legitimate consumer loan companies whose function is to provide unsecured loans to high-risk borrowers who are experiencing a shortage of liquidity. In many countries, including Japan and the United States, interest rates on revolving credit typically are much higher. Thus it seems unrealistic to assume that the official market and what Wu and Hu call the black market will be fully integrated under full liberalization. In fact, the finding that the difference between the two lending rates increased in Taiwan during recent years seems to support the view that, in fact, a complete segmentation of the bank lending market is taking place in Taiwan as a result of (and not in spite of) bank deregulation. In order to clarify this matter, it may be useful to provide evidence on how the relative sizes of the official and black markets changed during the sample period.