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A traditional argument against free banking is that it will collapse because of information externalities: it is impossible for depositors to tell whether a high deposit rate offered by a bank is due to its high efficiency or risky lending strategy. This paper shows that in a separating equilibrium a higher-quality bank offers a lower deposit rate and holds a smaller proportion of risky loans than a lower-quality bank to signal its underlying quality. Hence, free banking is not inherently unstable. The empirical results for the Hong Kong banking system during 1964–65 are consistent with the hypothesis of a separating equilibrium.

UNDER PERFECT INFORMATION, market forces would enforce "good" banking practice because profit-maximizing banks would choose strategies with zero probability of bankruptcy (Kareken and Wallace 1978). However, one argument against free banking is that it will collapse because of externalities due to asymmetric information.[1] "It is extremely difficult to distinguish between a relative high rate of return that is offered because of greater efficiency and one that is offered because the institution is also undertaking a much riskier strategy" (Goodhart 1988, p. 64) This leads to free-rider and externalities problems as well as contagious bank runs because depositors, particularly small ones, cannot discriminate between "healthy" and "problem" banks. Thus, there is no guarantee that competitive pressure would enforce "good" banking practice, and a central bank is required to correct market failures due to information asymmetry.

However, information asymmetry does not imply that market forces fail to ensure good banking practice. There is evidence that prior to the establishment of the FDIC depositors and note holders cared about banks' financial conditions and carefully scrutinized balance sheets (Kaufman 1988). The existence of small depositors should not hinder market discipline as long as some depositors monitor banks. The interesting question is how such depositors use available information to assess accu-

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1. For a recent survey of the literature, see Selgin and White (1994).

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rately their banks' underlying financial health. Because of confidentiality of their business, banks cannot reveal directly but have to signal the quality of their management and loan portfolios instead.

The notion of bank signaling to depositors is not new. Examples are capital (Cleveland and Huertas 1985, Dowd 1996), excess reserves (Greenbaum and Thakor 1989), suspension of convertibility and option clauses (Gorton 1985a, Dowd 1988, and Selgin 1993). Nor is the signaling game model in this paper innovative. Nonetheless, this paper sheds some light on our understanding of banking stability under laissez-faire [see Dowd (1992, 1996) for a survey]. First, it shows that a bank's deposit rate and risk-free assets holding can be a joint signal of bank quality. While deposit rates alone may be a "noisy" indicator, depositors can further use available information to monitor banks. In a separating equilibrium, a good bank signals its quality by offering a lower deposit rate and holding a higher proportion of liquid, risk-free asset than a bad bank. This bank-specific information may eliminate banking panics even in a non-Diamond banking system, that is, even where individual banks cannot completely diversify and there are no secondary markets for bank loans, equity, and deposits (Gorton and Haubrich 1987, pp. 305–9). Such a separating equilibrium means that asymmetric information does not necessarily lead to contagious bank runs. It should be stressed, however, that the signal here rules out contagions based on wrong attributions of "bad" banking only. Contagions may still arise if depositors expect bank loans to go sour for reasons independent of bank quality. Therefore, a role still exists for other supplementary anti-panic devices, such as suspension contracts.

Our results also contradict several arguments meant to justify reserve requirements; for example, that free banks hold too few reserves and too risky portfolios (Cothren 1987); that a central bank is needed because free banks have no incentives to hold the socially optimal level of reserves (Goodhart 1988, pp. 53–55); and that reserve requirements are needed because of the moral hazard problem associated with deposit insurance (Freeman 1988). Our results suggest not only that deposit insurance and lender of last resort are not necessarily required to prevent panics but also that, even without reserve requirements, "good" banks have incentives to hold reserves to signal their quality.

Besides its theoretical contribution, this paper provides a formal test of bank signaling. The absence of a central bank or lender of last resort in Hong Kong during 1964–65 serves as a laboratory to test whether "free" banks there signaled to prevent contagious runs. The empirical results support the signaling hypothesis. Finally, this paper proposes empirical procedures also applicable in testing other signaling hypotheses, particularly multisignaling.

1. THE MODEL

The setup is analogous to Carr and Mathewson (1992) and Milde and Riley (1988). To abstract from the owner-manager problem, the banker is assumed to also be the shareholder. Both banks and depositors are assumed to be risk neutral. A capital requirement is the only regulation: each bank has to commit the same amount (or per dollar deposit) of sunk equity investment, K, by posting an equity bond with the government.[2] As the source of bankruptcy cost, the bond has a value only when the bank remains solvent.[3]

Banks are classified into different types based on the bankers' quality, which varies because of differences in training, managerial skills, experience, and professional ethics. A bank's type is denoted by a random variable θ, where $\theta \in \Theta$, the set of all possible types. Bank quality affects the expected net return on assets—the loan project is reduced in value by θ.[4] The higher the value of θ, the lower is the bank's quality. At the beginning of the game, Nature determines the types of banks in the industry. For simplicity, assume only two types—"good" and "bad." After θ is realized, banks offer deposit contracts to depositors. Based on their own types, banks choose deposit rates, R, to maximize their expected profits.[5] The contracts are fixed rate and not state contingent because of costly state verification (Townsend 1979). For simplicity, assume demand deposits to be the only type of deposit. Redeemability on demand provides depositors incentives to monitor and discipline banks (Calomiris and Kahn 1991). This, together with K, provides incentives for banks to tell the truth about their own types. By normalization, each depositor has one dollar to invest. Although she does not know her bank's type, she has a prior belief about their distribution in the industry.

After receiving the deposit, the bank invests in a risk-free bond, which yields a risk-free rate of return, R_f, and a risky loan project. Let L and B, $0 < L,B < 1$, be the proportions of funds invested in the loan and the bond, respectively. The loan project is illiquid, with a maturity of two periods. Its value is zero before maturity and is $Q(L)\mu$ upon maturity, where $Q(L)$ is a production function satisfying $Q'(L) > 0$, $Q''(L) < 0$, and $Q(0) = 0$ and μ is a random variable uniformly distributed over $[0,1]$ to reflect project risk. Bankruptcy occurs when $\mu < \hat{\mu}$, where $\hat{\mu}$ is defined as

$$\hat{\mu} = \frac{R - BR_f + -K}{Q(L)} \,. \tag{1}$$

The depositor observes her bank's portfolio at the end of the first period via, say, its interim balance sheet. Based on the observed portfolio and R, she revises the expected return on her deposit and chooses deposit withdrawal ratio, W, which is assumed, for simplicity, to be either 1 or 0. If the expected return is less than the reservation rate

2. By normalizing deposit (and hence assets), we can view K as a legal capital-asset ratio.

3. During the U.S. free banking era, note-issuing banks were required to post bonds with state governments (Rockoff 1975). In modern banking, we can think of this as banks investing in industry-specific assets which lose their values if banks go bankrupt.

4. This additive and separable assumption simplifies the algebra and gives intuitive economic interpretations for inequality (9).

5. Alternatively, we can think of the banks as issuing convertible banknotes. The deposit rate is the implicit return on banknotes, which varies among different banknotes because of such factors like wider acceptability, more bank branches, etc.

of return, which is assumed, for simplicity, to be R_f, she will withdraw (that is, $W = 1$). When there is a premature deposit withdrawal, the bank is virtually insolvent because the loan project is illiquid. Therefore, both types of banks have incentives to avoid early withdrawals (bank runs).

At the end of the game, μ is realized. If the bank remains solvent, the depositor will get R as her payoff while the bank will get back K plus its profits. If the bank is insolvent, it will lose K whereas the depositor will get the realized value of its portfolio.

We consider cases in which both the bank and the depositor use pure strategies only. A pure-strategy perfect Bayesian equilibrium for this signaling game can be represented by a triple (s_b^*, s_d^*, p). The set of strategies s_b^* and s_d^* representing the bank's and depositor's strategies respectively satisfy the following conditions:

$$s_b^* \in \underset{R,L}{argmax} \mathrm{E}(\Pi((R,L), W((R,L));\theta)),\ \forall\ \theta \tag{2}$$

$$s_d^* \in \underset{W\in\{0,1\}}{argmax} \sum_{\theta} p(\theta|R,L)\mathrm{E}(Y((R,L), W((R,L));\theta)),\ \forall\ (R,L). \tag{3}$$

where

$$\mathrm{E}(\Pi) = \int_{\hat{\mu}}^{1} Q(L)\mu d\mu + (BR_f - R - \theta)(1-\hat{\mu}) - \mathrm{K}(\hat{\mu} + R_f - 1), \tag{4}$$

and

$$\mathrm{E}(Y) = R(1-\hat{\mu}) + \int_{0}^{\hat{\mu}} Q(L)\mu d\mu + (BR_f - \theta)\hat{\mu} = R_f. \tag{5}$$

Also, the depositor has a system of beliefs about the type of her bank, p, determined by Bayes' rule whenever possible, satisfying

$$p(\theta|R,L) = \frac{p(\theta)s_b^*}{\sum_{\theta'} p(\theta')s_b^*\ (R,L|\theta')} \tag{6}$$

if

$$\sum_{\theta'} p(\theta')s_b^*\ (R,L|\theta') > 0 \tag{7}$$

and p(θ |R,L) is any probability distribution over θ, the set of possible types, if

$$\sum_{\theta'} p(\theta')s_b^*\ (R,L|\theta') = 0 \tag{8}$$

Equations (4) and (5) are respectively the bank's expected profit and the depositor's participation constraint.

This model satisfies the single-crossing property, and a unique separating equilibrium satisfying the Cho-Kreps (1987) intuitive criterion exists when the following holds:[6]

$$P_b > \frac{\frac{1}{2}Q'(L)(1+\hat{\mu}) - R_f}{\frac{1}{2}\frac{Q'(L)}{Q(L)}} . \tag{9}$$

The left-hand side is the probability of finding a bad bank in the industry. The numerator on the right-hand side can be viewed as the spread between the expected rate of return on the risky loan and the risk-free rate in the nonbankruptcy states. This inequality suggests that good banks have incentives to signal when there are many bad banks or the opportunity cost of signaling is low.

The main properties of this separating, or Riley (1979), equilibrium are the following:

1. that the bad bank offers an equilibrium contract which is the same as the one under full information;
2. that each contract offers the depositor an expected rate of return equal to R_f; and
3. that both $L(\theta_i)$ and $R(\theta_i)$ are strictly increasing in θ_i: a bad bank offers a higher deposit rate and holds a larger proportion of its portfolio in risky loans.

If (9) is not satisfied and if the refinement concept of undefeated equilibrium (Mailath, Okuno-Fujiwara, and Postlewaite 1993) is applied, the outcome is a pooling equilibrium. So long as the expected return is not less than the required rate of return, depositors will not withdraw their deposits prematurely. It follows that both good and bad banks can make more profits from a pooling contract than from a separating contract whereas depositors are no worse off. These are main properties of this pooling equilibrium:

1. that both types of banks pool together and offer the same deposit contract; and
2. that, on average, depositors are expected to get their reservation rate of return of R_f;

2. SIGNALING AND CONTAGIOUS BANK RUNS

The above results imply that a free banking system is not necessarily inherently unstable despite asymmetric information. Banking stability depends on the initial equilibrium and depositors' posterior belief about the distribution of banks in the industry, which in turn affects both the (posterior) expected rate of return on deposits and whether (9) holds or not. If the initial equilibrium is pooling *and* if, for some

6. The derivation follows closely Riley (1985). All derivations and proofs are available upon request.

reason, depositors change their posterior belief and decide to withdraw their deposits, then there can be contagions.[7] Though financially sound, good banks are also subject to runs because, given the pooling contracts, depositors fail to discriminate between good and bad banks. In Diamond and Dybvig (1983), bank runs are purely panic based and can be triggered by intrinsically irrelevant random events, such as sunspots, that need not be related to the bank's condition (as bank assets in their model are riskless). Our model is also purely panic based because the factors affecting the depositor's posterior belief are not explicitly modeled. Nonetheless, the depositor's withdrawal decision in this model is based on relevant bank-specific information—the promised deposit rate and observed bank portfolio (and hence the expected return on deposit)—in the interim period. This is similar in spirit to informationally based bank run models, such as Gorton (1985a), Jacklin and Bhattacharya (1988) and Chari and Jagananathan (1988), in which interim information about the underlying bank investment returns plays an important role as the source of runs.

If the initial equilibrium is separating, bank runs cannot be contagious because depositors can identify good banks by the signal. If a run occurs, it will be a flight to quality. Similar to bank capital, the role of the signal here is for good banks to preclude contagions. Bank runs play an important role by providing incentives for depositors to monitor banks, as in Calomiris and Kahn (1991), and also for banks to signal their quality.[8] This differs from the cases of suspension of convertibility (for example, Gorton 1985a, Selgin 1993) and option clauses (for example, Dowd 1988). Furthermore, although the latter devices ideally serve as a signal as well as a therapeutic measure (Friedman and Schwartz 1963, pp. 163–68) to restore stability when a panic has begun, their role in practice is still debatable.[9] Empirical evidence is therefore needed to determine whether banks actually signal and, if so, what signal they use.

3. EMPIRICAL EVIDENCE

The Hong Kong banking system during 1964–65 was not entirely free because currency was not competitively supplied by all commercial banks.[10] But as far as the supply of deposits and banking regulations are concerned, it was largely free.

7. Runs will not occur if the initial equilibrium is pooling and depositors' posterior belief remains unchanged or becomes favorable.

8. Panics can be associated with demand deposits, but not banknotes, because the former do not circulate and therefore no secondary market efficiently prices them (Gorton 1985b, p. 272).

9. Gherity (1995) argues that the option clause in the Scottish case was a defensive device to protect individual banks against predatory rivals instead of runs by depositors. See Selgin and White (1997) for a rebuttal.

10. Under the currency board system, three private banks—the Hongkong and Shanghai Banking Corporation, the Chartered Bank (now the Standard Chartered Bank), and the Mercantile Bank—issued banknotes with a 100 percent foreign currency reserve requirement, whereas the government supplied coins and notes of small denomination.

Furthermore, there was no central bank, lender of last resort, discount window, or deposit insurance. The 1948 Banking Ordinance imposed virtually no regulations such as minimum reserve and capital ratios, except an annual license fee of $5,000 [see Jao (1974) for details]. The twenty-five local banks in our sample are quite representative because they ranged from small old-fashioned banks to large modern ones and accounted for more than one-third of the total assets of the industry.[11]

Four profitability measures—returns on assets (ROA), deposits (ROD), loans (ROL), and net worth (ROK)—for 1965 are used as proxies for bank quality.[12] Banks' liquidity ratios are used as a proxy for the proportion of risk-free assets held. The deposit rates on twelve-month time deposits under the Interest Rate Agreement are used to represent the deposit rates.[13] The Agreement merely confirmed that the smaller local banks had a higher cost structure than the larger, more firmly established banks (Jao 1974, p. 257).

The signaling hypothesis is tested using two "traditional" approaches and one "new" approach. The major testable implications of a signaling hypothesis are (I) the informationally consistent equilibrium response function is monotonic in the signal and (II) the signal is monotonic in the true type (Acharya 1988). The first approach (called the Signal-Outcome approach here) adopts (I) and tests whether in a separating equilibrium the observed signals reflect bank quality (and hence bank profitability), conditional on depositors' rational responses to the signals (that is, no premature deposit withdrawals).

Besides the signaling variables, two firm-specific control variables are included: (i) the loan-deposit ratio as a proxy for the riskiness of the bank; and (ii) bank size (the log of total asset) as a proxy for market share and to capture the effect, if any, of economies of scale. The regression model is

$$Y_i = \alpha_0 + \alpha_1 L_i + \alpha_2 R_i + \sum_{j=1}^{N_1} \alpha_{j+2} X_{ij} + \varepsilon_i \, . \tag{10}$$

where Y_i is the profitability of the ith bank,
L_i is the liquidity ratio of the ith bank,
R_i is the deposit rate of the ith bank,
X_{ij} are the control variables affecting profitability, and
ε_i is a random disturbance term.

Under the signaling hypothesis of a separating equilibrium, $\alpha_1 > 0$ and $\alpha_2 < 0$.

11. Our sample excludes the Hong Kong and Shanghai Banking Corporation and its wholly owned subsidiary bank, because of its note-issuing status, and another two banks newly formed in late 1964.

12. There were no bond ratings for the local banks, and the limited information revealed in their balance sheets rules out the possibility of using bad debts or bad-debt provisions as a proxy.

13. The Agreement aimed at ending an interest rate war by imposing maximum deposit rates. Banks were divided into two broad categories—foreign banks and local banks. The latter were further divided into four categories according to their depository bases [see Jao (1974, pp. 53–56) for details]. However, they were free to offer rates on deposits with maturities of eighteen months or longer.

The second (State-Signal) approach uses (II) above and is in the spirit of Miller (1983). In a signaling equilibrium the state variable (that is, true type) determines the signal but not vice versa. From this causality, the following equations are estimated:

$$R_i = \delta_0 + \delta_1\theta_i + \sum_{k=1}^{N_2}\delta_{k+1}W_{ik} + \mu_i \,. \tag{11}$$

and

$$L_i = \lambda_0 + \lambda_1\theta_i + \sum_{l=1}^{N_3}\lambda_{l+1}Z_{il} + \nu_i \,. \tag{12}$$

where θ_i is the quality of the ith bank (proxied by bank profitability),

W_{ik} are the control variables affecting the deposit rate,
Z_{il} are the control variables affecting the liquidity ratio,
μ_i and ν_i are random disturbance terms,
and other variables are as previously defined.

Under the signaling hypothesis, $\delta_1 < 0$ and $\lambda_1 > 0$. The loan-deposit ratio, bank size, and capital-asset ratio are included as control variables in both equations, assuming a bank's liquidity policy is related to its portfolio choice and capital policy, and also there are possible economies of scale in holding reserves (for example, Slovin and Sushka 1975). Although bank profitability for one year is a reasonable proxy for bank quality, it creates an error-in-variable problem mainly because banks cannot perfectly forecast their profitability and, even if they could, profitability for only one year is an imperfect proxy for the long-run soundness. Because of this error-in-variable problem and heteroskedasticity of an unknown form, the H2SLS method by Cragg (1983) is applied. Bank profitability for 1964 is used as an instrument because past profitability is usually highly correlated with future profitability and should not be correlated with the current choices of deposit rates and liquidity.[14] All the regressors (except bank profitability for 1965) and the deposit-asset ratio are used as instruments, assuming a bank's asset size, deposit size, and capital are all exogenous or predetermined when it chooses its deposit rate and liquidity ratio.

In testing a signaling hypothesis, multisignaling in particular, the conventional linear regression framework has certain potential problems, including (1) unknown or nonlinear functional form,[15] (2) nonadditive interaction effects between the signals, and (3) multicollinearity. These problems lead to difficulties in making tractable analysis and meaningful interpretations. Therefore, a two-stage approach is proposed here. The first stage applies cluster analysis (for example, Everitt 1993) to

14. Our data show a high correlation between banks' profitability for 1965 and 1964. For example, the R^2 is 0.6309 for ROA.

15. For example, see Makhija and Thompson (1986) for a nonlinear dividend signaling model.

classify the data according to the signals, and the second stage tests the prediction(s) of the signaling hypothesis. Apart from overcoming the above problems, it has at least three potential advantages. First, it is applicable to multisignaling as well as cases where the signals cannot be quantifiable in a meaningful scale. Second, it is intuitively appealing as far as interpretation is concerned: if there is really a signaling mechanism, then we should be able to classify the signal senders into separate groups by the signal(s) alone. Third, it is analytically more tractable than the other two approaches. For example, in this study if banks cannot be perceived as distinguishable groups based on the signals alone, then the signaling hypothesis can be rejected immediately. If there are m clusters of banks and one with the lowest deposit rates and the highest liquidity ratios, we can proceed to test that this control group has on average higher profitability than the others by an ANCOVA model:

$$Y_i = \beta_0 + \sum_{m=1}^{M} \beta_m D_m + \sum_{j=1}^{N_1} \beta_{m+j} X_{ij} + \varepsilon_i \, . \tag{13}$$

where Y_i is the profitability of the ith bank,

> D_{im}s are dummy variables, that is, $D_{im}=1$ if bank i belongs to the mth group, zero otherwise,
> X_{ij} are the concomitant variables, and
> ε_i is a random disturbance term.

As in (10), the concomitant variables are the loan-deposit ratio and bank size. Under the signalling hypothesis, $\beta_m < 0, \forall\, m$.

Table 1 reports the results of the Signal-Outcome approach. To correct heteroskedasticity, detected in all except the ROK equation, WLS are applied using the reciprocal of bank size as a deflator.[16] As the results reveal, all the coefficients for the deposit rate have the correct negative sign, though statistically insignificant, whereas those for the liquidity ratio are significant and have the correct positive sign.

Tables 2 and 3 report the results of the State-Signal approach. For (11), the coefficients of the bank quality variable, though small in magnitude, all have the correct negative sign and are statistically significant. For (12), the coefficients of the bank quality variable all have the correct positive sign. They are all statistically significant except in the ROL equation. For both regressions, the Sargan tests do not reject the joint hypothesis of correct specification and valid instruments (Davidson and MacKinnon 1993, pp. 235–37).

For the two-stage approach, the pseudo-F statistic (Caliniski and Harabasz 1974) suggests three clusters in the sample.[17] The clustering results enable us to test not

16. The OLS residuals are correlated with the reciprocal of bank size, indicating a higher variability in the smaller banks' profitability than in the larger banks. One plausible explanation is that the former consist of mainly poor-quality banks which had a lower-than-average expected return but higher-than-average risk.

17. Milligan and Cooper's Monte Carlo study (1985) shows that the pseudo-F statistic has the best performance among thirty indices in recovering the correct number of clusters.

TABLE 1

RESULTS OF THE SIGNAL-OUTCOME APPROACH

Dependent Variable: Rate of Return
Number of Observations: 25

Rate of Return:	ROA	ROD	ROL	ROK
		Equation		
Intercept	4.0490	9.9059	11.5440	−68.6721
	(0.209)	(0.295)	(0.295)	(−0.566)
Liquidity Ratio	0.1634	0.2532	0.3325	0.8479
	(3.955)**	(3.535)**	(3.985)**	(3.179)**
Deposit Rate	−0.7124	−1.3434	−1.4966	−2.8563
	(−0.517)	(−0.563)	(−0.539)	(−0.330)
Loan-Deposit Ratio	7.023×10^{-2}	11.919×10^{-2}	9.722×10^{-2}	21.001×10^{-2}
	(4.431)**	(4.340)**	(3.039)**	(2.017)*
Bank Size	−0.4134	−0.8073	−0.8365	3.2425
	(−0.690)	(−0.777)	(−0.691)	(0.864)
Method	WLS	WLS	WLS	OLS
$\bar{R}^2$	0.4595	0.4244	0.4029	0.4971
F	6.101**	5.424**	5.049**	6.932**
RMSE	0.2662	0.4612	0.5373	7.2933
Condition No.	228.82	228.82	228.82	223.77
DW	1.172	1.319	1.528	1.188
White's χ^2 Test	16.53	18.94	17.30	7.9941

NOTES: Figures in brackets are t-statistics, and †, *, ** denote respectively significance at the 10 percent, 5 percent, and 1 percent levels, one-tail test.

TABLE 2

RESULTS OF THE STATE-SIGNAL APPROACH

Dependent Variable: Deposit Rate
Number of Observations: 25

Proxy for Quality:	ROA	ROD	ROL	ROK
		Equation		
Intercept	11.2681	11.4686	11.6876	10.3234
	(9.149)**	(9.716)**	(9.955)**	(5.604)**
Bank Quality	-7.789×10^{-2}	-4.389×10^{-2}	-4.012×10^{-2}	-1.543×10^{-2}
	(−2.330)*	(−2.527)**	(−2.072)*	(−1.765)*
Loan-Deposit Ratio	1.661×10^{-3}	2.067×10^{-3}	0.498×10^{-3}	0.2871^{-3}
	(1.268)	(1.447)†	(0.286)	(0.156)
Capital-Asset Ratio	1.4357	1.3397	1.1963	1.1730
	(2.186)*	(2.065)*	(1.773)*	(1.728)*
Bank Size	−0.2881	−0.3008	−0.3051	−0.2264
	(−4.381)**	(−4.775)**	(−4.526)**	(−2.176)*
Method	H2SLS	H2SLS	H2SLS	H2SLS
R^2 between observed and predicted	0.8369	0.8413	0.8322	0.8080
RMSE	0.1964	0.1938	0.1990	0.2127
DW	1.9702	1.9414	2.093	1.9894
Sargan's χ^2 Test	2.4369	2.4535	2.2603	2.5250

NOTES: Figures in brackets are t-statistics, and †, *, ** denote respectively significance at the 10 percent, 5 percent, and 1 percent levels, one-tail test.

TABLE 3
RESULTS OF THE STATE-SIGNAL APPROACH
Dependent Variable: Liquidity Ratio
Number of Observations: 25

Proxy for Quality:	Equation ROA	ROD	ROL	ROK
Intercept	−31.6810 (−0.973)	−33.0483 (−0.987)	−41.0495 (−1.259)	−27.2397 (−0.695)
Bank Quality	1.2102 (1.980)*	0.6902 (1.887)*	0.4417 (0.984)	0.2056 (1.480)†
Loan-Deposit Ratio	−0.3451 (−3.824)**	−0.3434 (−3.725)**	−0.3389 (−4.000)**	−0.3084 (−3.602)**
Capital-Asset Ratio	0.4058 (2.126)*	0.4003 (1.972)*	0.4994 (2.971)**	0.4643 (2.453)*
Bank Size	4.0139 (2.478)*	4.0971 (2.467)*	4.4592 (2.747)**	2.0381 (1.744)*
Method	H2SLS	H2SLS	H2SLS	H2SLS
R^2 between observed and predicted	0.7170	0.6995	0.7042	0.7107
RMSE	4.5491	4.6867	4.6354	4.5980
DW	1.5785	1.5767	1.6409	1.6749
Sargan's χ^2 Test	0.5513	0.6532	1.0852	1.1736

NOTES: Figures in brackets are *t*-statistics, and †, *, ** denote respectively significance at the 10 percent, 5 percent, and 1 percent levels, one-tail test.

only the signaling hypothesis but also the "operational efficiency" hypothesis—an operationally efficient bank can invest more in loans and offer a higher deposit rate. If the former is true, Group 0 banks are expected to have higher profitability on average than the others.[18] If the latter is true, Group 2 banks should have the highest profitability on average. Both hypotheses can be rejected if either Group 1 banks have the highest average profitability or there is no systematic relationship in profitability. As before, the reciprocal of bank size is used as a deflator to correct heteroskedasticity. The ANCOVA results (Table 4) indicate that the signs of the dummy variables are all negative and statistically significant. The empirical results under the three different approaches are all consistent with the signaling hypothesis of a separating equilibrium.

Limited data availability prior to 1964 precludes a panel data study.[19] Nevertheless, a few episodes enhance the reliability of the above results. First, the Bank of East Asia and Nanyang Commercial Bank (both in Group 0) had reportedly been maintaining over the years higher liquidity ratios and more conservative interest rate policies than their competitors.[20] For example, at the peak of the interest rate war in

18. The clusters are labelled as Groups 0, 1, and 2 respectively. Group 0 (the control group) has three banks, an average deposit rate of 6.08 percent and an average liquidity ratio of 37.86 percent. The corresponding figures are 14, 6.11 percent, and 25.33 percent for Group 1 and 8, 6.44 percent, and 15.28 percent for Group 2.

19. Local banks were not legally required to publish their balance sheets before the 1964 Banking Ordinance.

20. See also Jao (1974, pp. 193–96) for an analysis of the local banks' liquidity during the 1950s and 1960s. In brief, these two banks were among the most liquidity-conscious banks, whereas other local banks, like Hang Seng Bank, were less circumspect about their liquidity.

TABLE 4
THE TWO-STAGE APPROACH: ANCOVA RESULTS
Dependent Variable: Rate of Return
Number of Observations: 25

Proxy for Quality:	Equation ROA	ROD	ROL	ROK
Intercept	−0.7243 (−0.155)	−0.5250 (−0.067)	1.0349 (0.112)	−80.9466 (−2.825)**
Group 1 Dummy	−1.8982 (−2.387)*	−3.1609 (−2.362)*	−4.7831 (−3.049)**	−6.8146 (−1.421)†
Group 2 Dummy	−4.0456 (−4.023)**	−6.5939 (−3.896)**	−8.7466 (−4.408)**	−20.2064 (−3.307)**
Loan-Deposit Ratio	7.314×10^{-2} (4.390)**	12.629×10^{-2} (4.505)**	10.440×10^{-2} (3.176)**	23.671×10^{-2} (2.294)*
Bank Size	−0.0672 (−0.266)	−0.1844 (−0.433)	−0.0725 (−0.145)	4.4915 (2.924)**
Method	WLS	WLS	WLS	OLS
$\bar{R}^2$	0.4405	0.4378	0.4096	0.5357
F	5.724**	5.672**	5.163**	7.922**
RMSE	0.2708	0.4558	0.5343	7.0082
Condition No.	55.69	55.69	55.69	56.19
DW	1.662	1.857	1.935	1.474
White's χ^2 Test	17.83	17.25	15.95	9.94

NOTES: Figures in brackets are *t*-statistics, and †, *, ** denote respectively significance at the 10 percent, 5 percent, and 1 percent levels, one-tail test.

September 1961, they offered 6.5 percent p.a. for twelve-month time deposits, lower than the 7 percent offered by their major competitors like Hang Seng, Wing Lung, and Ka Wah. Thus, these two banks' strategies were unlikely to be short-term, idiosyncratic ones observed in 1964 only. Reflecting their profitability, they recorded considerable growth in net worth over the years and were among the dominant players in the industry. In contrast, consider the Far East Bank and the Yau Yue Bank (both in Group 2). The former was in financial difficulties in late 1965, had to hypothecate its assets to the Hongkong and Shanghai Bank in order to get financial support, and was finally taken over by the First National City Bank in 1969. The latter also faced financial difficulties and eventually went under in 1966. Further consider the Canton Trust and Commercial Bank, which failed in February 1965. According to available data, it had a low liquidity ratio of 18.1 percent at the end of 1963 and offered a deposit rate of 8 percent in September 1961, higher than most of its competitors.

4. CONCLUSION

This paper explains why, from a signaling perspective, high liquidity and conservative interest rate policies have traditionally been associated with prudent, good banking practice. If a separating equilibrium prevails, information asymmetry does not lead to contagious bank runs and free banking system failure. The empirical results provide evidence in favor of the signaling hypothesis. However, a free banking system is not entirely immune to contagious runs: in some cases a pooling equilibrium may prevail, so that changes in depositors' posterior belief lead to deposit withdrawals. Yet even this does not imply that deposit insurance, central banking, or other government interventions are the only feasible ways to overcome market failures due to imperfect information. Other devices, such as a clearinghouse acting as a lender of last resort and issuing clearinghouse loan certificates (for example, Gorton and Mullineaux 1987; Timberlake 1984), option clauses, and suspension of convertibility are also feasible. The challenge facing economists, bankers, and regulators is to find the least costly solution to maintain banking stability and efficiency.

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