

THE BANKING BUSINESS IN A MULTI-INDUSTRY GAME: SHOULD COMPLEXITY BE ADDRESSED BY SEQUENTIAL ELABORATION?

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ABSTRACT

We address the issue of simulating the banking business in a multi-industry game from the standpoint of both the game designer and the game administrator. For the game designer, we apply classical equilibrium arguments to formulate a mathematical model of the interbank interest rate. For the game administrator, we lay out the options for participant involvement, considering particularly if participants should be involved with businesses that are not banks before they can be involved with banks, the sequential-elaboration method of addressing game complexity. The results of our study using a semester-long computer-assisted business game that involved at its peak 152 students who by the end of the semester had founded 439 firms in the banking industry and five nonbanking industries suggest that sequential-elaboration habituates participants to a way of thinking that blinds them to new conditions that requires new thinking. The issues addressed are meant for business games designed to give participants practice in business administration, rather than for games designed to indoctrinate participants in business concepts.

INTRODUCTION

Even though the banking business undergirds all businesses of the modern economy, not much work has appeared in the simulation literature as to how the banking business is to be simulated in a business game. An early effort in this direction was made by Schreier (1979), who reviewed the Bank Management Simulation (BankSim), apparently developed by the American Bankers Association and the Federal Deposit Insurance Corporation. Schreier describes a classically designed batch-processed game of eight episodes, each episode representing a quarter of a year, with additional information given to participants after each of the two simulated years. BankSim participants are divided into teams, each team managing a bank that competes with banks managed by other teams. Teams make decisions on sources of funds (Fed Funds, CDs, and time deposits) and uses of funds (investment portfolios and loan portfolios). Later efforts include Chandrachai's (1990) description of BANKGAME and Cretien's (1992) description of BANKPRO. Both BANKGAME and BANKPRO share BankSim's classical batch-processing design, except that BANKPRO also can be administered as an independent-across-participants game, participant versus computer. Neither Schreier nor Chandrachai nor Cretien discussed the model used to simulate the supply and demand for deposits and loans, and none of the three banking simulations allow for participants to engage in other businesses besides the banking business.

Here, we go beyond describing a functional banking game such as BankSim, BANKGAME, and BANKPRO, wherein participants can only be involved with banks, to consider a game wherein participants are involved with businesses that are not banks as well as with businesses that are banks, all within the same game. In such a game, each bank faces peer-to-peer competition from other banks, but each bank also must contend with supplier-to-customer conflicts with the businesses that are not banks. Two issues that must be resolved in such a game are (a) the model that determines how commercial banks relate to the nation's central bank and (b) the process by which participants are allowed to become involved with banks and nonbanking firms. The model should be of particular interest to those who seek to design a game that involves banks; the process should be of particular interest to those who seek to administer a game that involves both banks and other kinds of businesses.

MODEL

Although a model of the relationship between commercial banks and the nation's central bank is principally a model of the supply and demand for money, classical product-demand models, such as Gold & Pray's (1983, 1984, 1990) and their extensions (Cannon, Cannon, & Schwaiger, 2009; Cannon & Schwaiger, 2005; Gold & Pray, 2001; Goosen, 2009; Teach, 2007), are not applicable, because of two fundamental differences. First, whereas the classical models accept price and other variables such as promotional expenditures and product quality as inputs, giving quantity demand as outputs, the relationship is inverted in banking, for the monetary quantities are inputs and the price of money, the interest rate, is output. Second, whereas the classical models considers firms to be the suppliers of products that are demanded by virtual customers, in banking, commercial banks are both suppliers and demanders of money, for in any period of activity, the bank that has taken in more in deposits than it needs to meet its requirements is a net supplier of money, whereas the bank that finds itself in the obverse position is a net demander of money.

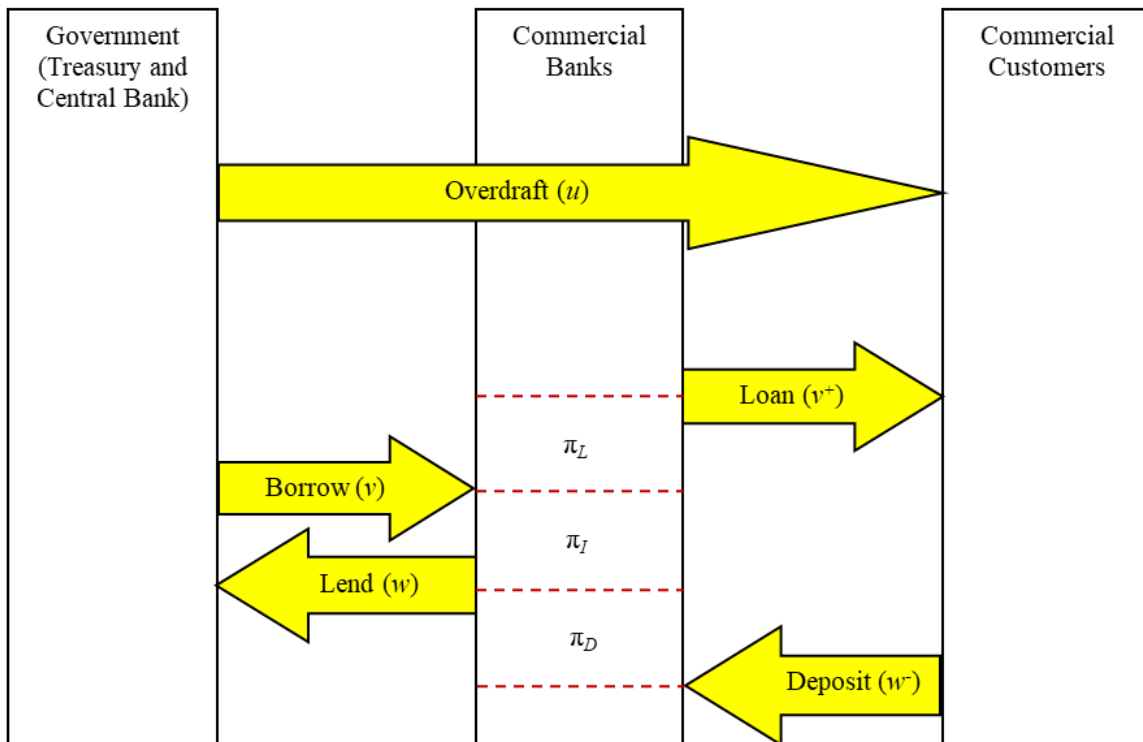
A model relating the aggregate supply and demand for money to the interest rate can be simple if an ad hoc one suffices. A linear relationship between the interest rate and commercial bank's demand for money net of supply would be simple. If a more complex relationship is desired, then Goosen and Kusel (1993) suggests that the model interpolate between points such that the entire demand curve is a series of interconnected linear segments. As Gold (1993) argues, however, interactive effects can greatly complicate the interpolation approach.

Ad hoc models do not account for the nature of the underlying phenomenon, so participants would learn little about the business simulated by studying the model in depth. If the model should account for the nature of the phenomenon, however, then studying the model would be educationally worthwhile. If moreover that model should also be mathematically simple, the result would be elegant.

Our model locates the interest rate that is the equilibrium point between the supply and demand for money. The model assumes a government that encompasses the functions of both the nation's treasury and its central bank, as illustrated in Figure 1. The government defines the following interest rates:

- u : Ceiling interest rate
- v : Interest rate that the government charges on loans to commercial banks, for the United States, the federal discount rate
- w : Interest rate that the government pays on deposits by commercial banks, for the United States, the rate on treasury bills

**FIGURE 1
MODEL OF THE BANKING SYSTEM**



Banks profit from accepting commercial deposits (π_D), extending commercial loans (π_L), and arbitraging funds (π_I) between v and w . A bank's total profit (π_T) is the sum of these three, as specified by Equation 1.

**EQUATION 1
TOTAL PROFIT OF COMMERCIAL BANKS**

$$\pi_T = \pi_D + \pi_L + \pi_A \tag{1}$$

The government imposes a reserve requirement on commercial deposits. We define that requirement together with related basic variables as follows:

- k : The proportion of cash to commercial deposits that a commercial bank must hold
- r_j : Cash reserve required of bank j
- l_j : Loanable funds gross of reserve requirements of bank j
- d_j : Deposits held by bank j
- c_j : Cash position of bank j
- f_j : Lending of bank j to the government and to other commercial banks
- g_j : Borrowing of bank j from the government and from other commercial banks

The aggregated reserve requirements (R) and the aggregated loanable funds gross of reserve requirements (L) for an economy of n banks are as specified by Equations 2 and 3, respectively.

EQUATION 2 AGGREGATED RESERVE REQUIREMENTS OF COMMERCIAL BANKS

$$R = \sum_{j=1}^n r_j = k \sum_{j=1}^n d_j \quad (2)$$

EQUATION 3 AGGREGATED LOANABLE FUNDS OF COMMERCIAL BANKS

$$L = \sum_{j=1}^n l_j = \sum_{j=1}^n (c_j + f_j - g_j). \quad (3)$$

Based on the difference between aggregate loanable funds gross of reserve requirements and aggregate reserve requirements, we analyze three cases: $L = R$, $L > R$, and $L < R$. For all three cases, we take first the circumstance of banks operating without an interbank market, and then consider how the banks' profitability might be increased with an interbank market. For all three cases, we define the following working variables:

- x : Marginal quantity deposited in a commercial bank by a commercial customer
- y : Marginal quantity that the commercial bank may loan because of x , thus $y = x(1 - k)$

We shall show that the interbank interest rate for all three cases (i_1 , i_2 , and i_3) are the same when $L = R$, and that the slope of the curves for the latter two cases between the interest rate and L/R is the same at the point of intersection. Thus, the curves connect smoothly where they meet.

Case 1: $L = R$

Without an interbank market, a well-managed bank with insufficient cash to meet its reserve requirement covers the shortage by borrowing from the government. Likewise, a well-managed bank with surplus cash deposits the surplus with the government. Thus, the net cash position of a well-managed bank is always equal to its reserve requirement.

Given that the banks of our model are all well managed, a marginal deposit of quantity x enables the deposit-receiving bank to earn a marginal profit on the deposit that is the difference between the interest rate it applies to its deposit customer on the full amount of the deposit (w) and the interest rate it obtains on the amount net of the reserve requirement that it deposits with the government (w). Thus, for Case 1, the bank receiving a marginal deposit would realize a deposit profit (π_{D1}) as specified in Equation 4.

EQUATION 4 MARGINAL DEPOSIT PROFIT OF COMMERCIAL BANKS WITHOUT AN INTERBANK MAR-

$$\pi_{D1} = -w^-x + wx(1 - k) \quad (4)$$

Similarly, a marginal loan of quantity y enables the loan-extending bank to earn a marginal profit on the loan that is the difference between the interest rate that it gets from its loan customer (v^+) and the interest rate that it owes to the government to fund the loan (v). Thus, for Case 1, the bank receiving a marginal loan would realize a loan profit (π_{L1}) as specified in Equation 5.

EQUATION 5
MARGINAL LOAN PROFIT OF COMMERCIAL BANKS WITHOUT AN INTERBANK MARKET

$$\pi_{L1} = v^+y - vy \quad (5)$$

If the bank that receives the deposit also is the bank that extends the loan, and if the net amount deposited is the same as the amount loaned, so that $y = x(1 - k)$, then an arbitrage profit of the two transactions can be realized by applying the net amount received from the deposit to the loan, avoiding governmental intermediation. Thus, for Case 1, the bank receiving both a marginal deposit and a marginal loan would realize an arbitrage profit (π_{A1}) as specified in Equation 6.

EQUATION 6
MARGINAL ARBITRAGE PROFIT OF COMMERCIAL BANKS WITHOUT AN INTERBANK MARKET WHEN AGGREGATED LOANABLE FUNDS EQUALS AGGREGATED RESERVE REQUIREMENTS

$$\pi_{A1} = (v - w)y = (v - w)x(1 - k) \quad (6)$$

Competition among banks will drive both π_{D1} - and π_{L1} to zero, so at equilibrium, Equation 4 reduces to $w^+ = w(1 - k)$ and Equation 5 reduces to $v^+ = v$. Nevertheless, π_{A1} remains, either to be realized by the fortunate bank, absorbed by the government, or split among banks through interbank lending and borrowing. The splitting of arbitrage profits is therefore the rationale for interbank transactions.

We define the Case 1 equilibrium interbank interest rate (i_1) as the rate that would prevail if the nation were composed of many competitive banks of essentially equal strength and equal competency in attracting deposits and loans from commercial customers, so that no bank can by its own actions substantially affect i_1 , and every bank is equally likely to be approached by a customer with a marginal commercial deposit and a customer desiring a marginal loan. Given an interbank market for deposits and loans, the bank receiving a marginal deposit would realize at equilibrium a deposit profit (π'_{D1}) as specified by Equation 7.

EQUATION 7
MARGINAL DEPOSIT PROFIT OF COMMERCIAL BANKS WITH AN INTERBANK MARKET WHEN AGGREGATED LOANABLE FUNDS EQUALS AGGREGATED RESERVE REQUIREMENTS

$$\pi'_{D1} = -w^-x + i_1x(1 - k) = -w(1 - k)x + i_1x(1 - k) \quad (7)$$

Likewise, the bank receiving a marginal loan would realize at equilibrium a loan profit (π'_{L1}) as specified by Equation 8.

EQUATION 8
MARGINAL LOAN PROFIT OF COMMERCIAL BANKS WITH AN INTERBANK MARKET WHEN AGGREGATED LOANABLE FUNDS EQUALS AGGREGATED RESERVE REQUIREMENTS

$$\pi'_{L1} = v^+y - i_1y = vx(1 - k) - i_1x(1 - k) \quad (8)$$

Symmetry of conditions between lending banks and borrowing banks mandates that $\pi'_{D1} = \pi'_{L1}$, Equation 9 holds. Collecting terms, we have the result of Equation 10.

EQUATION 9
SYMMETRY CONDITION BETWEEN MARGINAL DEPOSIT AND MARGINAL LOAN WITH AN INTERBANK MARKET WHEN AGGREGATED LOANABLE FUNDS EQUALS AGGREGATED RESERVE REQUIREMENTS

$$-w(1 - k)x + i_1x(1 - k) = vx(1 - k) - i_1x(1 - k) \quad (9)$$

EQUATION 10
EQUILIBRIUM INTERBANK INTEREST RATE WHEN AGGREGATED LOANABLE FUNDS EQUALS AGGREGATED RESERVE REQUIREMENTS

$$i_1 = \frac{w + v}{2} \quad (10)$$

Case 2: $L > R$

For the case of $L > R$ without an interbank market, any bank with an initial reserve-requirement shortage ($c_i < kd_i$) will rectify the shortage through government borrowing, so every bank will have either cash just sufficient to meet its reserve requirement or a surplus. Inasmuch as no bank has a cash shortage, a bank receiving a marginal deposit would realize a deposit profit (π_{D2}) of zero, that is,

EQUATION 11
MARGINAL DEPOSIT PROFIT OF COMMERCIAL BANKS WITHOUT AN INTERBANK MARKET WHEN AGGREGATED LOANABLE FUNDS EXCEEDS AGGREGATED RESERVE REQUIREMENTS

$$\pi_{D2} = -w(1 - k)x + wx(1 - k) = 0 \quad (11)$$

Under the same condition, a bank receiving a marginal loan would realize a loan profit (π_{L1}) that is bolstered by its bargaining position, which depends on how it might finance the loan in the absence of an interbank market. Without an interbank market, if the loan falls on a bank that does not have surplus loanable funds, the bank must borrow the funds from the government at interest rate v , but if the loan falls on a bank that does have surplus loanable funds, then the bank can apply its surplus loanable funds to the loan, at the opportunity-cost interest rate of w , the interest rate that the government pays for deposits. Thus, the expected interest-rate cost of a marginal loan depends on the number of banks without surplus loanable funds (n_1) relative to the number of bank with surplus loanable funds (n_2). The probability, p , of a marginal loan falling randomly on a bank without surplus loanable funds is specified by Equation 12.

EQUATION 12
PROBABILITY OF A MARGINAL LOAN FALLING RANDOMLY ON A BANK WITHOUT SURPLUS LOANABLE FUNDS WITH REFERENCE TO NUMBER OF BANKS WITH AND WITHOUT SURPLUS LOANABLE FUNDS

$$p = \frac{n_1}{n_1 + n_2} \quad (12)$$

In the perfectly competitive case of many banks, each of a quantum size, the loanable funds of every bank will be l , so $L = (n_1 + n_2)l$. The n_1 banks with surplus loanable funds will each hold deposit d , so for these banks $l = kd$. The n_2 banks without loanable funds will hold no deposit, so for them, $d = 0$ and $l = 0$. So, $R = n_1kd = n_1l$, giving rise to Equation 13.

EQUATION 13
PROBABILITY OF A MARGINAL LOAN FALLING RANDOMLY ON A BANK WITHOUT SURPLUS LOANABLE FUNDS WITH REFERENCE TO AGGREGATED RESERVE REQUIREMENTS RELATIVE TO AGGREGATED LOANABLE FUNDS

$$p = \frac{R}{L} \quad (13)$$

Accordingly, a bank with a marginal loan can expect a loan profit (π_{L2}) as specified in Equation 14.

EQUATION 14
EXPECTED LOAN PROFIT OF A BANK WITH A MARGINAL LOAN WHEN AGGREGATED LOANABLE FUNDS EXCEEDS AGGREGATED RESERVE REQUIREMENTS

$$\pi_{L2} = vy - vpy - w(1 - p)y \quad (14)$$

With interbank borrowing and lending in Case 2, a bank receiving a marginal deposit can expect at equilibrium a deposit profit (π'_{D2}) that is the same as that of Case 1 (Equation 7), and a bank receiving a marginal loan can expect at equilibrium a loan profit (π'_{L2}) that is the same as that of Case 1 also (Equation 9). Symmetry between the chance of a bank getting a marginal deposit and its chance of getting a marginal loan mandates that $\pi'_{D2} - \pi_{D2} = \pi'_{L2} - \pi_{L2}$, giving rise to Equation 15.

EQUATION 15
SYMMETRY CONDITION BETWEEN A MARGINAL DEPOSIT AND A MARGINAL LOAN
WITH AN INTERBANK MARKET WHEN AGGREGATED LOANABLE
FUNDS EXCEEDS AGGREGATED RESERVE REQUIREMENTS

$$-w(1-k)x + i_2x(1-k) - 0 = vx(1-k) - ix(1-k) - vy + vpy + w(1-p)y \quad (15)$$

Matching quantities, considering that $y = x(1-k)$, and collecting terms, we have the result that when $L > R$ the equilibrium interbank interest rate (i_2) is as specified in Equation 16.

EQUATION 16
EQUILIBRIUM INTERBANK INTEREST RATE WHEN AGGREGATED
LOANABLE FUNDS EXCEEDS AGGREGATED RESERVE REQUIREMENTS

$$i_2 = w + \left(\frac{v-w}{2}\right)p = w + \left(\frac{v-w}{2}\right)\frac{R}{L} \quad (16)$$

Case 3: $L < R$

The arguments of Case 3 mirror those of Case 2. For the case of $L < R$ without an interbank market, any bank with surplus cash will dispose of the surplus through government lending, so every bank will have either cash just sufficient to meet its reserve requirement or a shortage. Inasmuch as no bank has a surplus of cash, a bank receiving a marginal loan would realize a loan profit (π_{L3}) of zero, as specified by Equation 17.

EQUATION 17
MARGINAL LOAN PROFIT OF COMMERCIAL BANKS WITHOUT AN
INTERBANK MARKET WHEN AGGREGATED RESERVE REQUIREMENTS
EXCEEDS AGGREGATED LOANABLE FUNDS

$$\pi_{L3} = vY - vY = 0 \quad (17)$$

A bank receiving a marginal deposit would realize a loan profit (π_{D3}) that is bolstered by its bargaining position. If the marginal deposit falls randomly on a population of quantum-sized banks such that m_1 of the banks do not have a reserve-requirement shortage and m_2 do, then the probability, q , of a marginal deposit falling randomly on a bank without a reserve-requirement shortage is specified by Equation 18:

EQUATION 18
PROBABILITY OF A MARGINAL LOAN FALLING RANDOMLY ON A BANK WITHOUT
RESERVE-REQUIREMENT SHORTAGE WITH REFERENCE TO NUMBER OF BANKS
WITH AND WITHOUT RESERVE-REQUIREMENT SHORTAGE

$$q = \frac{m_1}{m_1 + m_2} \quad (18)$$

Paralleling the perfect-competition argument of Case 2, if the deposit held by each quantum-sized bank is d , then the reserve requirement of every bank is kd , so $R = (m_1 + m_2)kd$. For m_1 of the banks, $l = kd$; for m_2 of the banks, $l = 0$. So, $L = m_1l = m_1kd$, giving rise to Equation 19.

EQUATION 19
PROBABILITY OF A MARGINAL DEPOSIT FALLING RANDOMLY ON A BANK
WITHOUT RESERVE-REQUIREMENT SHORTAGE WITH REFERENCE TO AGGREGATED
LOANABLE FUNDS RELATIVE TO AGGREGATED RESERVE REQUIREMENTS

$$q = \frac{L}{R} \quad (19)$$

If the marginal deposit falls on a bank without reserve-requirement shortage, that bank, in the absence of interbank lending, would have to deposit the surplus with the government at the interest rate of w , but if the marginal deposit falls on a bank with reserve-requirement shortage, the bank can apply the deposit to repay the government loan that was incurred to meet the reserve requirement, saving the interest rate of v . Accordingly, the bank receiving a marginal deposit can expect a deposit profit (π_{D3}) as specified by Equation 20.

EQUATION 20
EXPECTED DEPOSIT PROFIT OF A BANK WITH A MARGINAL DEPOSIT WHEN
AGGREGATED RESERVE REQUIREMENTS EXCEEDS AGGREGATED LOANABLE FUNDS

$$\pi_{D3} = -w(1-k)x + wqx(1-k) + v(1-q)x(1-k) \quad (20)$$

The base cases remaining the same in this case as in Case 1, a bank receiving a marginal deposit can expect a deposit profit (π'_{D3}) that is the same as that of Case 1 (Equation 7), and a bank receiving a marginal loan can expect a loan profit (π'_{L3}) that is the same as that of Case 1 also (Equation 8). Symmetry between that chance of a bank getting a marginal deposit and its getting a marginal loan mandates that $\pi'_{D3} - \pi_{D3} = \pi'_{L3} - \pi_{L3}$, giving rise to Equation 21.

EQUATION 21
SYMMETRY CONDITION BETWEEN A MARGINAL DEPOSIT AND A
MARGINAL LOAN WITH AN INTERBANK MARKET WHEN AGGREGATED
RESERVE REQUIREMENTS EXCEEDS AGGREGATED LOANABLE FUNDS

$$-w(1-k)x + i_3x(1-k) + w(1-k)x - wqx(1-k) - v(1-q)x(1-k) = vx(1-k) - ix(1-k) - 0 \quad (21)$$

Collecting terms, we have the result that when $L < R$ the equilibrium interbank interest rate (i_3) is as specified in Equation 22.

EQUATION 22
EQUILIBRIUM INTERBANK INTEREST RATE WHEN AGGREGATED RESERVE

$$i_3 = v - \left(\frac{v-w}{2}\right)q = v - \left(\frac{v-w}{2}\right)\frac{L}{R} \quad (22)$$

Thus, the relationship between the interbank interest rate and loanable funds is linear in the region $L < R$ (Equation 22) and curvilinear in the region $L > R$ (Equation 16). The two curves intersect at $L = R$, when $i_1 = i_2 = i_3 = (w + v) / 2$. Moreover, the slope of Equation 16 is as specified in Equation 23.

EQUATION 23
SLOPE OF INTERBANK INTEREST RATE RELATIONSHIP WHEN
AGGREGATED LOANABLE FUNDS EXCEEDS AGGREGATED RESERVE REQUIREMENTS

$$\frac{di_2}{dL} = -\left(\frac{v-w}{2}\right)\frac{R}{L^2} \quad (23)$$

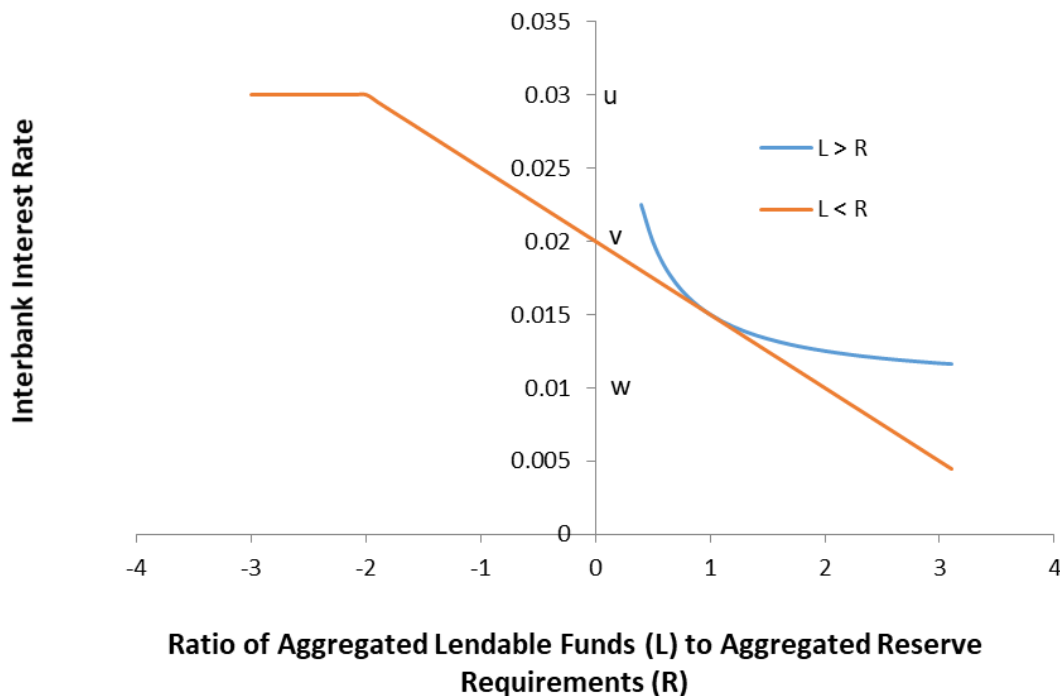
The slope of Equation 22 is as specified in Equation 24.

EQUATION 24
SLOPE OF INTERBANK INTEREST RATE RELATIONSHIP WHEN
AGGREGATED RESERVE REQUIREMENTS EXCEEDS AGGREGATED LOANABLE FUNDS

$$\frac{di_3}{dL} = -\left(\frac{v-w}{2}\right)\frac{1}{R} \tag{24}$$

At the intersection of the two curves, when $L = R$, the slope is the same, so the two curves connect smoothly where they meet. A graph of the two curves when $u = 3\%$, $v = 2\%$, and $w = 1\%$ is shown in Figure 2. The spiced curve has its upper bound at u and its lower bound at w .

FIGURE 2
INTERBANK INTEREST RATE MODELED UNDER TWO CONDITIONS



PROCESS

The fundamental choice in a game that includes both banks and nonbanking firms is the choice of sequence. Should the game begin with nonbanking firms followed by banks (Option A), or with both banks and nonbanking firms at the same time (Option B)? The third logical possibility of beginning the game with banks followed by nonbanking firms is not viable, as banks work with money that would be pointless without nonbanking firms to produce products that money can buy.

Option A, the sequential-elaboration method (Cannon, 1995; Cannon, Friesen, Lawrence, & Feinstein, 2009; Cannon, Feinstein, & Friesen, 2010) for dealing with complexity, may give rise to the least stressful experience for business students, because it begins with the kind of businesses that are more often discussed in business courses than the banking business. If this reasoning is correct, then the banks in a game where banks that appear later should generally be more successful than the banks of Option B. On the other hand, a game that does not include banks at the start may cause the participants to overlook important differences between banks and nonbanking firms, to treat banks as if they were a nonbanking business, and therefore cause the banks to be generally less successful than they would have been than if the banks had appeared before or simultaneously with nonbanking firms. In terms of a general principle, the question is whether participants of a game perform better if they are exposed to the familiar before the unfamiliar, or vice versa, or both simultaneously.

With both options, if participants can choose the business with which they will be involved, they may choose not to be involving with banks, in which case the question arises as to how nonbanking firms are to be financed in the absence of banks. The first option is to allow nonbanking firms to deal directly with the government, thus placing deposits with the government at interest

rate v and borrowing from the government at interest rate w (Option X). The second option is to disallow both deposits and loans. In this case, firms with excess cash cannot earn interest on deposits, and firms that run short of cash would pay the overdraft interest rate of u (Option Y) to the government. Option X is easier on nonbanking firms than Option Y, so Option X fits the less stressful Option A better than Option B. On the other hand, Option Y better represents the important role bank play in the everyday world, so Option Y fits the less restrictive Option B better than the more restrictive Option A.

An important difference between nonbanking firms and banks is that whereas nonbanking firms are physically constrained in the volume of business they can transact, banks are not similarly constrained. The nonbanking firm cannot exceed the production capacity of its facility, machinery, and employees. The bank, however, can do as much business as regulation allows, because the business of banks is principally to move money, and the resources required to move money is not dependent on the amount of money that is moved. It costs no more to move \$10 from one account to another account than to move \$1 million between the same two accounts.

Thus, as income rises, more nonbanking firms can be created without undermining the profitability of all firms, because more resources are needed to produce more goods and nonbanking services, but more banks will give rise to less profitability of the banking business, because of the increased competition among banks, each of whom could, absent regulatory constraints, service the entire market by itself virtually without adding resources.

STUDY

The question of which option is best may be answered with an empirical test. We have results from a game that applies Option A-X. The game we use, GEO, supports extensive participant-participant interaction and leaves participants in control of outcomes, so by the classification system of Crookall, Martin, Saunders, and Coote (1986), the game is computer-assisted, rather than computer-controlled, computer-based, or computer-directed.

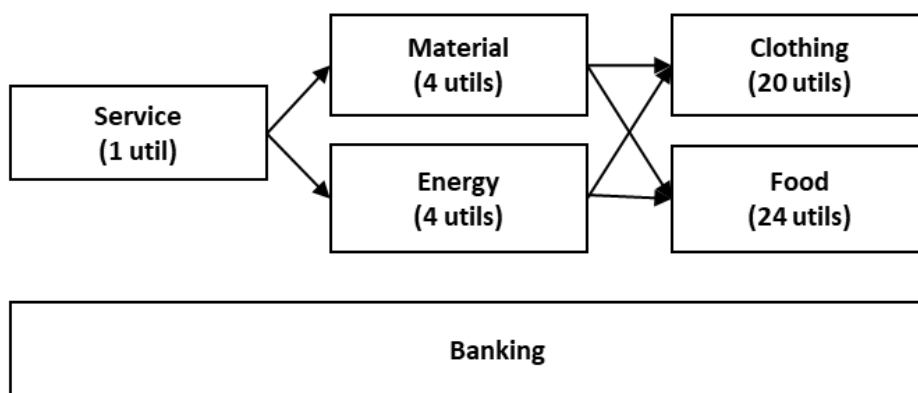
GAME ATTRIBUTES

Business games commonly are batch-processed games of 4 to 12 periods involving several firms competing in a single industry, each firm being managed by a team of students. The game of the study, however, is a continuously processing game of 160 periods involving as many firms as the participants choose to found in any of six different industries, namely, service, material, energy, clothing, food, and banking. Service products are needed to produce material and energy products that in turn are needed to produce clothing and food products.

The products of all firms in an industry are commodities of undistinguished quality. Each firm can produce the product of only one industry, but any nonbanking firm can change instantly between nonbanking industries. Thus, a firm in the service business can become a firm in the material business, and vice versa. A bank, however, cannot become a service business, and a service business cannot become a bank.

Participants purchase the products produced by the nonbanking firms to accumulate scores for which they receive credit towards grades. Scores are based on the utility value of products, with service products having the lowest utility value (1 util) and food having the highest (24 utils). The supply-chain relationship of the six industries and the utility value of products is shown in Figure 3.

**FIGURE 3
SUPPLY-CHAIN RELATIONSHIP AMONG INDUSTRIES**



To simulate the capacity constraints on nonbanking firms, the firms of the game have production capacities that rises in steps depending upon the number of executives each firm employs, augmented by an experience-curve effect. A food firm, for example, has beginning capacities of 3-10-20-35. That is, a newly founded food firm that employs no executive can produce in its first productive period 3 units of food. If the company employs one executive, its beginning capacity jumps to 10 units; if two

executives, to 20 unit; and if three executives, to 35 units. Production in subsequent periods rises by 5% for every doubling of experience, so if 20 cumulative units have been produced by the firm up to the current period, then the current period's production capacity would be 21 units, *ceteris paribus*. Consistent with the concept of a computer-assisted game, the executives employed must be real people, that is, the participants themselves, not virtual persons.

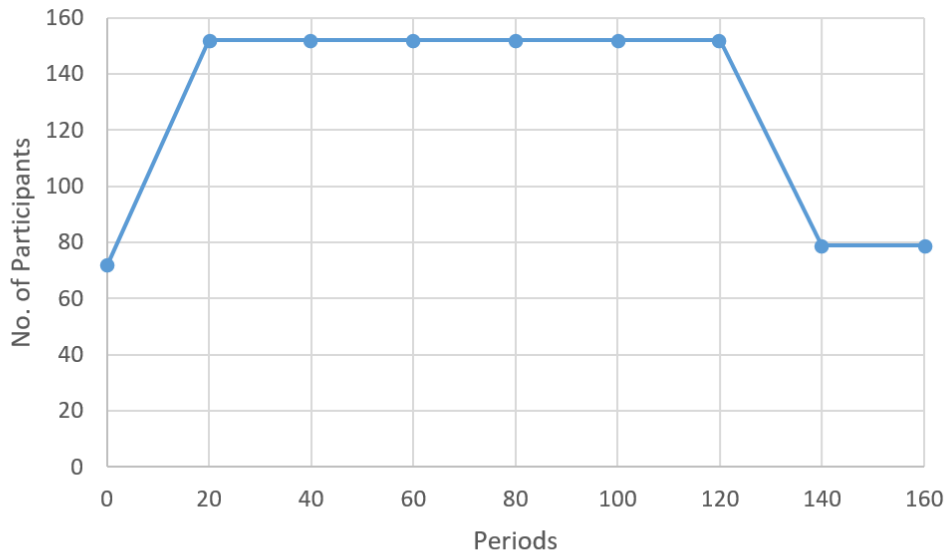
The banks of the game are limited to accepting deposits and issuing loans. Deposits and loans are automatically placed in the bank that offers the best rate, which would be the highest interest rate on deposits and the lowest interest rate on loans. All deposits and loans are government guaranteed, so deposits get their money back with interest in the event of a bank failure, and banks get their money back with interest when a loan customer becomes insolvent. Each bank has an opening for only one executive, its manager. If the manager's position is vacant, the bank cannot make loans.

To simulate the regulatory constraints on banks, a reserve requirement of 10% and a capital adequacy requirement of 10% also are imposed on banks. Thus, a bank must keep 10% of its deposits in non-interest-bearing cash. If a bank's available capital (total equities minus investments) should fall below 10% of its loan portfolio, it stops accepting deposits.

METHOD

The study reported here involved at its peak 152 students, 73 enrolled in an undergraduate business program in Hong Kong and 79 enrolled in an undergraduate business program in the United States. The game was administered over an entire semester. Hong Kong students joined the game about a week later and exited it about a week earlier than the U.S. students. A graph of the number of participants over the 160 periods of the game is shown in Figure 4.

**FIGURE 4
NUMBER OF PARTICIPANTS OVER THE 160-PERIOD DURATION OF THE GAME**



Participants were allowed found service firms at the start, followed by material and energy firms that were followed in turn by food, energy, and banking firms, as shown in Table 1. As shown, participants had about 14 days to found service firms before other firms became available, and about 23 days to found service, material, and energy firms before banks became available. The first bank was founded in Period 6, by which time 152 nonbanking firms had already been founded, about one firm per participant. By the end of the semester, the participants had founded 439 banks and nonbanking firms.

**TABLE 1
INDUSTRIES ACTIVATED OVER TIME**

Period	Duration (days)	Industry Activated
0-3	14	Service
3-5	9	Material and Energy
5-160	74	Clothing, Food, and Banking

RESULTS

Figures 5 through 10 are graphs of the number of profitable firms in relation to the total number of firms over the duration of the game in all six industries. The shape of the graph of the banking industry (Figure 10) is remarkable different from the shape of the graph of the nonbanking industries. Whereas the percentage of nonbanking firms that are profitable rises over the duration of the game, the corresponding percentage of banking firms falls over the same duration, as summarized in Table 2. The confirming correlations, ranging from .90 to .99 among nonbanking firms and from -.78 to -.91 between banks and nonbanking firms, are all statistically significant at two-tailed $p < .05$ or better, as shown in Table 3.

FIGURE 5
NUMBER OF SERVICE FIRMS OVER THE 160-PERIOD DURATION OF THE GAME



FIGURE 6
NUMBER OF MATERIAL FIRMS OVER THE 160-PERIOD DURATION OF THE GAME



FIGURE 7
NUMBER OF ENERGY FIRMS OVER THE 160-PERIOD DURATION OF THE GAME



FIGURE 8
NUMBER OF CLOTHING FIRMS OVER THE 160-PERIOD DURATION OF THE GAME

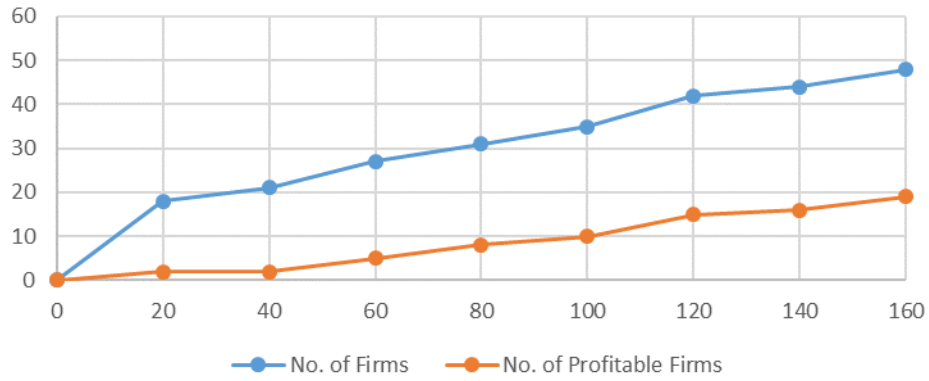


Figure 9
Number of Food Firms Over the 160-Period Duration of the Game

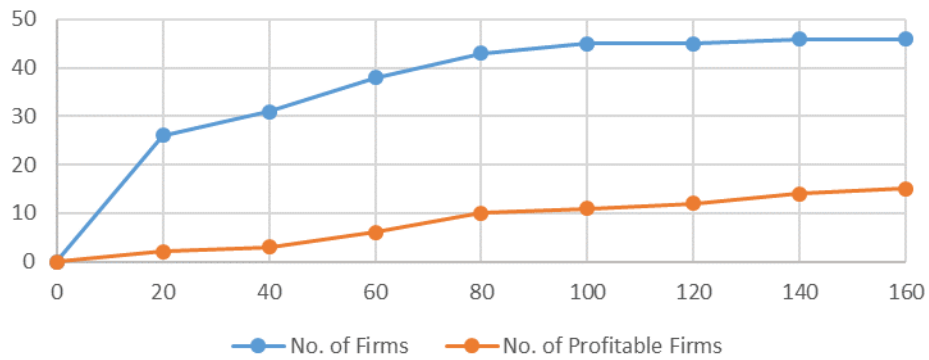


Figure 10
Number of Banking Firms Over the 160-Period Duration of the Game



TABLE 2
PERCENTAGE OF FIRMS THAT ARE PROFITABLE

Period	Service	Material	Energy	Clothing	Food	Banking
20	29.4%	18.2%	11.5%	11.1%	7.7%	72.0%
40	32.4%	17.6%	16.1%	9.5%	9.7%	50.0%
60	32.5%	22.2%	28.2%	18.5%	15.8%	27.8%
80	37.2%	22.6%	34.1%	25.8%	23.3%	27.3%
100	38.8%	27.6%	50.0%	28.6%	24.4%	28.6%
120	47.2%	38.1%	49.1%	35.7%	26.7%	23.5%
140	48.5%	36.9%	50.0%	36.4%	30.4%	15.1%
160	48.5%	36.4%	50.8%	39.6%	32.6%	15.1%

TABLE 3
PEARSON CORRELATION OF PERCENTAGE OF FIRMS THAT ARE PROFITABLE

	Service	Material	Energy	Clothing	Food
Material	.98**				
Energy	.90**	.90**			
Clothing	.96**	.95**	.96**		
Food	.94**	.90**	.96**	.99**	
Banking	-.81*	-.78*	-.89**	-.86**	-.91**

** $p < .01$, two-tailed
* $p < .05$, two-tailed

DISCUSSION

The results support the argument that the force of habit is strong. Participants, accustomed to founding more nonbanking firms as the economy expands, proceeded also to found more banks, not grasping that whereas each nonbanking firm is limited in its capacity to serve customers, banks have essential unlimited capacity. Accordingly, founding more nonbanking firms as the economy expands gives rise to a greater proportion of profitable nonbanking firms, because later-founded firms tend to be better managed than those founded earlier on account of learning. On the other hand, founding more banks under the same condition only increases the competition among firms, driving out the weaker banks and leaving the banking industry with a lower proportion of profitable banks.

The next step of our study is to apply Option B-Y, and see if the participants will approach the banking industry differently when all industries, including banking, are made available simultaneously. Will the profusion of choices prove too much for the participants, or will they employ strategic chunking (Cannon, 1995; Cannon, Friesen, Lawrence, & Feinstein, 2009; Cannon, Feinstein, & Friesen, 2010; Tangri, 1992) to separate banking from other businesses so as to enable them to adapt effectively to the differences?

While we might expect participants to deal with the complexity of a business game by strategic chunking, sequential elaboration, organizational specialization, and focusing on intermediate measures of performance (Cannon, 1995; Cannon, Friesen, Lawrence, & Feinstein, 2009; Cannon, Feinstein, & Friesen, 2010), the question for game administrators comes down to the question of which strategy to support when resources are limited and undesirable side effects are present. The results of this study suggest that sequential elaboration has the undesirable side effect of habituating participants to a way of thinking that blinds them to new conditions that require new thinking, an effect addressed many years ago by the Gestalt psychologist Norman Maier (1930), who called it “direction in thinking.”

CONCLUSION

The model that we have developed and the processes that we have outlined are meant for a kind of business game different from those that have dominated business education for the past 70 years. Our game is meant for practice. The game runs continuously over the duration of the semester, so that participants can practice as much as they wish to reach their desired level of

proficiency in business administration.

In contrast, classical business games are often promoted as useful for teaching students the content of the courses in which they are used. Thus, a marketing game is said to teach marketing concepts, and a strategic-management game is said to teach strategic-management concepts. If the concepts are faulty, then the games are counterproductive. The trap of counterproductive indoctrination may be avoided by designing games that are computer-assisted rather than computer controlled, by incorporating models that account naturally for the phenomenon they claim to simulate, and by testing concepts for their workability in the setting of the game.

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