Option Game Analysis on Financial Resource Supply in RMB Retail Market

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Abstract

The competence of supplying financial resource in RMB retail market becomes more severe as foreign banks are authorized to enter this market. Therefore, more and more researches on such competition come out. But they ignore the effect of supply timing on competence. It's a new perspective to analyze the supplying time using first-mover advantage according to option game theory. The traditional option game theory doesn't consider first-mover advantage which is obvious in banking. Therefore option game with first-mover advantage is more suitable for banking. According to the conclusions from this article's model, Chinese banks as leader will do their best to enlarge the first-mover advantage to defer the entry timing of foreign banks. Foreign banks as follower will try to conquer the disadvantages from first-mover advantage. But foreign banks don't succeed in acquiring more market-share in cities because first-mover advantage is great. Therefore they have to look for other ways to enter this market.

Keywords: RMB retail market, financial resource, option game, first-mover advantage

1. Introduction

On December 11, 2006, China's banking opens fully to foreign capital, and accordingly, RMB's retail market opens more. Under the "Legal Person Bank Orientation" policy, some foreign banks are transformed into legal person and began their RMB retail business. In this market, the suppliers become more and the competition becomes more severe and accordingly tremendous literature in this area come out. But China's literatures ignore such an aspect: the timing to take part in this market is important to the two suppliers in their competence. This article will analyze the timing for these two kinds of bank to supply financial resource according to option game theory and first-mover advantage. Smets (1991) combined game theory and real option to analyze the rational participants' tactful investment under uncertainty. And from then on, option game theory becomes a hot research focus. Dixit and Pindyck (1994) is a typical option game model. But this model doesn't consider the influence of first-mover advantage. But in banking, first-mover advantage is obvious. Tufano (1989), Mester (1995), Kim, Klige and Vale (2003), Berge and Astrid (2007) testify it is true that there is first-mover advantage in banking from the theoretical or empirical aspect. Ding (2012) proved that China's banking also has first-mover advantage. Therefore, option game theory considering first-mover advantage should be more suitable to China's banking. This article is arranged as following: the second part is the expanding of the traditional real option model considering first-mover advantage; the third part is the analysis on the reaction of China's local banks in RMB retail market; the forth part is the reaction of foreign banks in RMB retail market; the last part is the conclusion.

2. Expansion of Traditional Option Game Model Considering First-Mover Advantage

We consider two firms in an industry, each with the potential of one unit output. Thus the industry output is 0, 1, 2. There is sunk cost I and no variable cost. The demand function is $P=YD（Q）$. Y is the market multiplicative shock variable which follows the geometric Brownian motion $dY = aYdt + \sigma Ydz$. First-mover advantage is ΔC which means that the follower will pay ΔC more or earn ΔC less than the leader if it wants to sell one unit product.

2.1 Follower's Value When the Leader Has Invested

In this situation, the demand function of the follower is $P = Y(D(2) - \Delta C)$ because of first-mover advantage. Suppose the critical value for Y is Y_2^* at which it is optimal for the follower to invest. Y_2^* satisfies (Note 1):

$$Y_2^*(D(2) - \Delta C) = \frac{\beta_1}{\beta_1 - 1}\delta I \tag{1}$$

where $\beta_1 = \frac{1}{2} - (r - \delta)/\sigma^2 + \sqrt{[(r - \delta)/\sigma^2 - \frac{1}{2}]^2 + 2r/\sigma^2}$, and suppose $\beta_1 > 1$ to insure that $Y_2^* > 0$. r is the riskless

rate, δ is the current cash flow rate once invest, like the dividend rate of stock, satisfying $\delta = u - a$, where u is the total expect rate of return.

When $Y \geq Y_2^*$, the follower will invest at once. Following Dixit and Pindyck (1994)'s deduction, the follower's value is

$$V_2^* = \frac{Y(D(2) - \Delta C)}{\delta} - I \tag{2}$$

When $Y < Y_2^*$, the follower will wait other than invest. It will wait until Y reaches the critical value Y_2^*, when

its value will be $\frac{Y_2^*(D(2) - \Delta C)}{\delta} - I$, the present value of which will be (Note 2):

$$V_2^* = E[e^{-rT}][\frac{Y_2^*(D(2) - \Delta C)}{\delta} - I] = (\frac{Y}{Y_2^*})^{\beta_1}[\frac{Y_2^*(D(2) - \Delta C)}{\delta} - I] \tag{3}$$

where T is the time when Y reach Y_2^* firstly. Y_2^* is the tangent point of $\frac{Y(D(2) - \Delta C)}{\delta} - I$ and

$(\frac{Y}{Y_2^*})^{\beta_1}[\frac{Y_2^*(D(2) - \Delta C)}{\delta} - I]$.

All in all, the follower's value is

$$V_2^*(Y) = \begin{cases} \dfrac{Y_2 (D(2) - \Delta C)}{\delta} - I............Y \geq Y^* \\ (\dfrac{Y}{Y_2^*})^{\beta_1}[\dfrac{Y_2^*(D(2) - \Delta C)}{\delta} - I]......Y < Y^* \end{cases} \tag{4}$$

According to follower's value, Y_2^* is a decreasing function of ΔC. The bigger ΔC is，the bigger will Y_2^* be. That is if the first mover advantage is larger, the time when the follower enter will be deferred later.

2.2 The Leader's Value When the Leader Has Invested

The leader's value can be divided into two parts. One is the monopoly profit $E\left[\int_0^T e^{-rT} YD(1)dt\right]$ before the

follower enters, where T is the time when the follower enters. The other is the leader's profit when the follower has entered.

Case 1. Suppose $Y \geq Y_2^*$

The follower will enter at once. And the leader has no time to obtain monopoly profit. The price for the leader is $YD(2)$, which is different from the price $Y(D(2) - \Delta C)$ faced by the flower. The leader's value is

$$V_1^*(Y) = \frac{YD(2)}{\delta} \tag{5}$$

Where the sunk cost I is not considered because the leader has invested.

Case 2. Suppose $Y < Y_2^*$.

The follower will wait first and enter the market when Y reaches Y_2^* and before then, the leader monopolizes the market whose price is $YD(1)$. The present value of the leader is (Note 3):

$$V_1^*(Y) = E\left[\int_0^T e^{-rT} YD(1)dt\right] \tag{6}$$

where T is the time when the follower enters.

When Y reaches Y_2^*, the price for the leader is $YD(2)$, and from then on, the present value of the leader is

$$V_1^*(Y) = E[e^{-rT}]\frac{Y_2^* D(2)}{\delta} \tag{7}$$

Therefore, when $Y < Y_2^*$, the leader's value is

$$V_1^*(Y) = E\left[\int_0^T e^{-rT} YD(1)dt\right] + E[e^{-rT}]\frac{Y_2^* D(2)}{\delta} \tag{8}$$

All in all, the leader's value is

$$V_1^*(Y) = \begin{cases} \dfrac{YD(2)}{\delta}...........Y \geq Y^* \\[3mm] E\left[\int_0^T e^{-rT} YD(1)dt\right] + E[e^{-rT}]\dfrac{Y_2^* D(2)}{\delta}............Y < Y^* \end{cases} \tag{9}$$

3. Results from the Model

3.1 The Leader Will Try to Enlarge the First-Mover Advantage

According to the characteristic of demand function, $YD(1)$ is larger than $YD(2)$. Therefore, it is better for the leader to be a monopolist longer. The follower will enter when Y reaches Y_2^*. According to equation (1), Y_2^* is an increasing function of ΔC, which means that ΔC is larger, Y_2^* will be larger, and the time for the present Y to fluctuate to Y_2^* will be longer, and the leader will be a monopolist longer. Therefore the leader will try to enlarge ΔC to obtain longer monopoly time. At the same time, the consumer will be more accustomed to the leader's product and the first-mover advantage will be larger.

3.2 The Follower Will Try to Reduce the First-Mover Advantage and Enter the Market as Soon as Possible

According to equation (2) and (3), when ΔC increases, the follower's value will decrease. Therefore the follower will try to decrease ΔC to increase its value. At the same time, according to equation (1), when ΔC increase, the timing for the follower to enter is deferred, which is one of the reasons that the first-mover advantage is enlarged. It is better for the follower to enter as soon as possible to reduce the influence of first-mover advantage.

4. Application on RMB Retail Market

In banking, the reason for first-mover advantage mainly lies in switch cost which originated from the degree of satisfaction and the level of information asymmetry solution. Satisfaction is shown by the comfortable business environment, numerous branches, friendly interface of online banking and lower prices for satisfactory products and services. The information asymmetry is more serious when customers are more uncertain about the products' safety and convenience and may be more reluctant to accept these products. If the customer is more satisfied or more acquaintance with the bank, the customer will experience more switch cost when (s) he change banks, and the first-mover advantage of the leader will be more obvious.

4.1 Chinese Banks' Strategy as a Leader

After 2006, foreign banks in China can supply financial services in RMB retail market once they obtain the identity of "legal person". In the RMB retail market, especially in cities, Chinese banks are leaders while foreign banks are followers and Chinese banks have obtained certain monopoly profit for a time. According to the

conclusions of the above model, the leader will try to enlarge first-mover advantage to defer the entry timing of the follower. The Chinese banks really do so and first-mover advantage of Chinese banks has embodied clearer after many years' of progress.

The most outstanding advantage of Chinese banks is the intensive branches spread over the town and country, which can not be well matched by foreign banks in a short period. According to the report from China Banking Association, till the end of 2010, the branches of banks in China is 193,490 and 1514 built in 2010. But branches belong to foreign banks are negligible. Citibank, HSBC, Bank of East Asia, Hang Seng Bank, Standard Chartered Bank are the five foreign banks that expanded fastest in China. But in 2010, they only built 33 branches. Chinese banks' convenient RMB liquidation for the same city and that of across systems, numerous branches and relative more sound business system are inaccessible for foreign banks at present. Foreign banks have no superiority not only on branches, but also on credit card business. Till the end of 2012, only 3 foreign banks are authorized to open credit card business. More than 95% credit card business is monopolized by Chinese banks, which will bring high first-mover pressure from Chinese banks when foreign banks want to enter RMB retail market.

Chinese banks have kept on improving service level and obtain more loyalty from the customers. Just like Wang Qinghua, the secretary of CBRC saying in 2011, the whole banking pay much attention to improving banking services, try to supply diversified financial products, strengthen the construction of information-technology systems, enhance the reform of branches, enlarge coverage area of ATM, strengthen the staff-training, build the consumer right protection system and try to establish "the most friendly and trustable bank".

For Chinese banks, especially those national commercial banks, the state invisible guarantee is their strong support. In the eye of ordinary people, the risk tolerance ability of these banks is more powerful. Besides, Chinese banks are more familiar with China undoubtedly. These make the customer face certain switch cost in banking where information asymmetry is outstanding.

All in all, when customers want to convert to foreign banks, they will face a certain switch cost and Chinese banks have some first-mover advantage.

4.2 Foreign Banks' Strategy as a Follower

Foreign banks do not accomplish nothing in reducing the pressure from Chinese banks' first-mover advantage and try to enter RMB retail market as soon as possible.

On Dec. 24, 2006, the nine foreign banks, Standard Chartered Bank, Bank of East Asia, HSBC, Hang Seng Bank, Mizuho Corporate Bank, Bank of Tokyo-Mitsubishi UFJ, DBS Bank, Citibank, ABN AMRO Bank, were authorized to obtain "legal person" status. On Apr. 23, 2007, HSBC, Bank of East Asia, Standard Chartered Bank, Citibank began to supply RMB retail services to local residents. The foreign banks that transform or supply RMB retail service early are those with solid economic strength. According to the ranking of "the Banker" in 2013, Citibank ranks 5th, HSBC 3rd, Bank of Tokyo-Mitsubishi UFJ 9th, Mizuho Corporate Bank 41st, Standard Chartered Bank 33rd and DBS Bank 58th. Although Bank of East Asia and Hang Seng Bank rank lower, but the two banks are from Hongkong, therefore they are more familiar with China.

The timing of foreign banks into China also affects the first-mover advantage. The 9 banks who obtain "legal person" status earliest also enter China very early. Table 1 shows the entry time into China of the 9 banks. Until 2006, they have been to China at least more than 10 years and some even more than 20 years. They may be more familiar with China and can resolve the information asymmetry problem better.

The most restriction for foreign banks in RMB retail market is that their branches are few, which affects switch cost heavily. Foreign banks transformed to "legal persons" have more branches than other foreign banks, and undoubtedly far less than Chinese banks. Table 2 shows the five foreign banks that have the most branches which occupied 49% of that of all the foreign banks. After 2006, foreign banks' branches enlarged faster and reached 412 till 2012. The five banks still have the most branches.

Besides expanding branches, more and more foreign banks began to invest in advertisement to make more residents accustomed with them, reduce the information asymmetry and then decrease the switch cost. The vice president of Citibank said their bank would make more efforts on advertising just on the day that Citibank was authorized as a "legal person". Citibank, HSBC, Standard Chartered Bank always invest much on advertising and are well known to the public. But from 2011, some unfamiliar banks, such as UBS, Jpmorgan, BNP Paribas, Royal Bank of Scotland, DBS Bank began to advertise in China's media.

Table 1. Entry timing into China of foreign banks who got "legal person" status earliest

Foreign banks	Entry Year
Standard Chartered Bank	1985
HSBC	1986
Bank of Tokyo-Mitsubishi UFJ	1986
Bank of East Asia	1987
Mizuho Corporate Bank	1987
Citibank	1988
ABN AMRO Bank	1993
DBS Bank	1994
Hang Seng Bank	1995

Resource: Almanac of China's finance and banking.

Table 2. Number of branches of foreign banks until the end of 2006

Foreign banks	Number of branches until 2006
HSBC	31
Bank of East Asiass	31
Standard Chartered Bank	20
Citibank	13
Hang Seng Bank	15

Resource: Almanac of China's finance and banking, 2007.

Foreign banks have advantage on abundant strength, global business work, management model, risk control mechanism and mature financial product. On the one hand, abundant strength is a way to resolve information asymmetry, on the other hand, it can make the bank to invest more on advertisement to make the customer more acquainted with this bank and then to reduce information asymmetry. The acquaintance with China's market also affects the switch cost, which is still connected with information asymmetry. Foreign banks who come to China earlier or whose motherland is nearer to China, will be more familiar with China, and local customer may trust them more, and the switch cost for the customer from Chinese banks to foreign banks will be less.

5. Conclusions

In RMB retail market, where Chinese banks are leader while foreign banks are follower, Chinese banks will increase customer satisfaction degree, decrease information asymmetry to enlarge the first-mover advantage, defer foreign banks entry and earn monopoly profit longer. However, foreign banks will take all kinds of measures to release the disadvantage from the first-mover advantage to enter earlier. But, their expansion in main cities in China is not successful, which means that the pressure from the first-mover advantage is large. But they will not reconcile themselves with so little share in this market, they may find other way to enter the market faster. For example, they may enter the rural RMB market, where they can act as a leader and avoid the pressure from first-mover advantage and in fact they enter this market very fast.

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References

Allen, N. B., & Astrid, A. D. (2007). Entry into Banking Markets and the Early-mover Advantage. *Journal of Money, Credit and Banking*, *39*(4), 775–807. http://dx.doi.org/10.1111/j.1538-4616.2007.00046.x

Calem, P. S., & Mester L. J. (1995). Consumer Behavior and the Stickiness of Credit-Card Interest Rates.

American Economic Review, *85*(5), 1327–1336.

Ding, S. J. (2012). Analysis on Opportune Moment of: Foreign Banks' Entry into China's Rural Financial Market from the Perspective of Real Option. *Journal of Shandong Normal University, 57*(5), 116–121.

Ding, S. J. (2012). *The Study on the Entry Timing of Foreign Banks from the Perspective of Real Option*. Shandong University.

Dixit, A., & Pindyck, R. (1994). *Investment under Uncertainty*. New Jersey: Princeton University Press.

Kim, M., Kliger, D., & Vale, B. (2003). Estimating Switching Costs: The Case of Banking. *Journal of Financial Intermediation*, *12*(1), 25–56. http://dx.doi.org/10.1016/S1042-9573(02)00005-0

Liu, Y., Yang, D. Q., & Zhang, S. D. (2008). A Study on the Reasonable Limits of Credit Expansion and Real Estate Price Fluctuations. *Finance & Trade Economics*, *8*, 15–21.

Tufano, P. (1989). Financial Innovation and First-mover Advantages. *Journal of Financial Economics*, *25*(2), 213–240. http://dx.doi.org/10.1016/0304-405X(89)90082-2

Wang, G. H., & He, D. X. (2010). Competition Effect of Foreign Banks into China. *Research on Financial and Economic Issues*, *7*, 62–69.

Zhang, J. Q., & Wu, Y. H. (2010). A Study for Threshold Effects of Foreign Bank Entry's Influence on the Efficiency of Domestic Commercial Bank: Evidence from Commercial Banks in China. *Journal of Financial Research, 6*, 60–74.

Notes

Note 1. The derivation process can be referred to Dixit and Pindyck (1994, p. 295).

Note 2. The calculation of $E[e^{-rT}]$ can be referred to Dixit and Pindyck (1994, p. 284).

Note3. The calculation of $E\left[\int_0^T e^{-rT} Y dt\right]$ can be referred to Dixit and Pindyck (1994, p. 295).

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