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The diffusion pattern of non-cash payments: Evidence from China

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Abstract

Exploiting an original dataset of non-cash payments during the period between 1996 and 2005, this study analyzes the diffusion patterns of non-cash payments in China. Based on both exponential and Gompertz curves, the POS (Point of Sale) terminal has shown a higher diffusion rate than that of ATMs (Automatic Teller Machines). This result is also robust when a time trend is interacted with rivals' precedence, network effects and market concentration. The diffusion rates of both ATM and POS terminals have accelerated after 2002, when *UnionPay* was established in China. The diffusion rate of ATMs is found to be mainly driven by rivals' adoption of them. Market concentration boosts the diffusion of POS terminals. In spite of the rising number of POS terminals and merchants, the volume of POS transactions is low. The diffusion rate of POS is, however, negatively affected by interchange fees.

Key words: diffusion pattern, non-cash payments, Automatic Teller Machines, Point of Sale, exponential curve, Gompertz, rivals' precedence, network effects, market concentration.

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1 Introduction

The proliferation of bankcards and non-cash payment technologies, such as ATMs (Automated Teller Machines) and POS (Point of Sale) terminals, has been one of the most relevant innovations in payment systems over the past several decades. The usage of electronic cards has reduced transaction costs and has also enhanced economic efficiency. Compared with cash, non-cash payments have several advantages, such as convenience and security. If all paper-based payments are replaced by alternative electronic instruments within a country, annual savings could amount to approximately 1% of GDP. (Shy and Tarkka 2002; Humphrey et al. 2003)

Global non-cash payment transactions continued growing at an average rate of 6.8% in 2001 - 2009. After a decline during the financial crisis, it began to pick up again in 2010 at an estimated annual growth rate of 7.8%.[2] The emerging and mature Asian-Pacific markets have dearly contributed to the recovery of non-cash payments.

After the first credit card was introduced by the Bank of China in 1985, the Chinese non-cash payment market has witnessed steady growth. Figure 1 illustrates the infrastructure of non-cash payment instruments in China. We observe that the number of payment cards has grown far more rapidly than ATMs and POS terminals. The number of POS terminals and merchants recruited increased more quickly than ATM machines. In addition to showing the improvement in infrastructure, Figure 2 illustrates that the rise of non-cash transactions has gone through two stages. Before 1998, the non-cash payment market maintained very low transaction values. The fast-track development of non-cash payment transactions can be seen after 2002, when the national organization – China *UnionPay* – was established. The transfer and withdrawal values continue to grow more rapidly than POS figures. In spite of the presence of relatively fewer ATMs than POS terminals, this phenomenon implies that the Chinese customers prefer convenient cash withdrawal to POS transactions. The promotion of the "*UnionPay*" brand has enhanced the adoption of bankcard usage. At the end of 2005, China ranked as the second largest market in the world in terms of the issuance of plastic cards. Until 2009, the annual growth of card usage in China was 20.8%, which is higher than the average growth of non-cash transactions globally (World payment report; Worthington and Lu 2007). By exploiting a dataset of bankcard and non-cash payment instruments[3], this study investigates the diffusion pattern of non-cash payment instruments in the Chinese market. It is valuable to investigate how and to what extent a financial innovation can affect the banking business in China.

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[2] The data are released by the World Payment Report from Capgemini, The Royal Bank of Scotland (RBS), and the European financial marketing association (EFMA). Before the financial crisis (2001 - 2007), the annual growth rate was 7.2%.

[3] Unlike in developed countries, the Chinese payment card market has long been dominated by debit cards and quasi-credit cards, instead of credit cards. Therefore, the terminology of "Bankcard" seems more appropriate than others in terms of the Chinese non-cash payment system.

The paper is organized as follows. Section 2 reviews the literature on the diffusion of payment cards and highlights the major contributions of this work. Section 3 describes the data, empirical approach and variables employed in the estimation. The empirical results are presented in Section 4. Section 5 concludes.

2 Literature Review

Most theoretical studies of non-cash payments focus on the two-sided nature and network externality of the payment market, such as Rochet and Tirole (2002, 2006), Wright (2003, 2004) and Guthrie and Wright (2007). They explained how interchange fees can affect merchants' acceptance and consumers' usage of payment cards. Qi and Yang (2003) propose a neural network model to predict the adoption behavior of credit cardholders. Using a nonlinear utility function and variable Marginal Rate of Substitution (MRS), they find consumers' adoption of credit cards to be likely to follow a nonlinear utility function and they do not make linear tradeoffs between card attributes. Masters and Rodríguez-Reye (2005) investigated the credit card acceptance in the context of heterogeneous sellers. They provided an explanation of how credit cardholders in different countries use the cards in different ways and then argued that the retailers' adoption of credit cards is not affected by other sellers' decisions.

In terms of empirical studies, Hannan and McDowell (1984) examined the relationship between market structure and ATM adoption levels. They found a positive impact of market concentration on the diffusion of ATMs in the banking industry. A higher proportion of firms tend to accept ATMs in a relatively concentrated market. Antonides et al. (1998) used a wide range of secondary data and S-shaped curves to estimate the adoption pattern of ATM and bankcards. The results implied a higher adoption level of bankcards than of ATM machines. Social learning was considered to be the main driver of this process. The determinants of ATM are revised by Hannan and McDowell (1984) and for ATMs and POS by Carbó-Valverde and Rodriguez-Fernández (2008). Both studies find that supply factors are the driving components of ATM and POS diffusions. As for the growth rate of ATM and POS transactions, they are negatively correlated, which could be explained by type of "horse race".

The study of Chinese non-cash payments is, nonetheless, limited in the international literature. Worthington (2003, 2005) conducted an exploratory study of the Chinese non-cash payment market and concluded that the Chinese payment card market is quite unique. Worthington et al. (2007, 2011) explored the holding and usage of credit cards of urban-affluent and early adopters. Their findings suggested that credit cards are more easily adopted by young and urban-affluent consumers in China. On the other hand, in spite of the respondents' appreciation of the convenience of credit cards, the "infrastructure" level and a fear of loss of financial control may be a barrier to credit card diffusion.

Almost all of the previous studies focused on the adoption of payment cards in China from the perspective of the cultural environment rather than payment instruments. Our paper contributes to the literature by investigating the diffusion pattern of non-cash payments in China from the perspective of network effects, infrastructure level and market concentration.

3 Empirical methodology

We employ a discrete model proposed by Mansfield (1968) to investigate the diffusion pattern of innovation. We assume that the diffusion rate of a payment instrument at time t+1 is a function of the diffusion at time t. Following this assumption, both Exponential and Gompertz curves are employed to estimate the diffusion rates of ATMs and POS over time. The expression for the exponential curve is as follows:

$$y(t) = y_0(1+r)^t \tag{1}$$

where $y(t)$ is the adoption level of an innovation – ATM or POS – in this framework. y_0 stands for the initial adoption level of ATMs (or POS), and the growth rate is denoted as r. We then take a Log–linear transformation of the exponential curve as follows:

$$\log y(t) = \log y_0 + t \times \log(1+r) \tag{2}$$

An alternative method to estimate the diffusion rate of an innovation is a Gompertz growth curve. It was initially proposed by Benjamin Gompertz in 1825 to forecast fertility distributions. Then, it was widely used to estimate telephone, automobile and ATM adoption (Migon and Gamerman 1993; Dargay and Gately 1997). The Gompertz curve expression is as follows:

$$y(t) = S \times \exp[-\alpha \times \exp(-\beta \times t)] \tag{3}$$

Where $y(t)$ is the adoption level of an innovation and S stands for the saturation level of the adoption. The parameter α determines the flatness of the curve. The diffusion speed of ATMs (or POS) is measured by β. Because the saturation level of ATM or POS adoption is difficult to observe, we use the first - difference log transformation to fit the Gompertz curve (Franses 1994). First, we take the log transformation of equation (3). We then take the first - difference of log[$y(t)$] to remove the saturation level, as shown in (5). Lastly, after the log transformation of equation (5), we obtain a linear function of the time variable, as shown in equation (6).

$$\log[y(t)] = \log S - \alpha \cdot \exp(-\beta \cdot t) \quad (4)$$

$$\Delta\log[y(t)] = \exp(-\beta \cdot t) \cdot (-\alpha + \alpha \exp \beta) \quad (5)$$

$$\log[\Delta \log y(t)] = -\beta \cdot t + \log(\alpha \exp \beta - \alpha) \quad (6)$$

Based on the models above, we propose the following empirical methods of both exponential and Gompertz curves to estimate the diffusion of ATMs and POSs in the Chinese market. The panel-data approach with fixed effects is implemented to control for unobservable cross-sectional individual differences.

$$\log y_{it} = \alpha + \beta \cdot t_i + \varepsilon_{it} \quad (7)$$

$$\log[\Delta \log y_{it}] = \alpha - \beta \cdot t_i + \varepsilon_{it} \quad (8)$$

Following Hannan and McDowell (1984), we adopt a two-step strategy to investigate the determinants of ATM and POS diffusion rates. In the first step, we use the Gompertz curve to estimate the ATM and POS diffusion rates of each individual bank, which are measured by coefficient β. In the second step, we use the bank level β as the dependent variable and an OLS method to estimate the determinants of diffusion rates. The mean values of rivals' precedence, market concentration, network effect, the growth of ATMs (or POSs) and other control variables for all banks are employed as explanatory variables.

4 Data and variables

An unbalanced panel of the annual number of ATMs and POS terminals is applied in the estimation. Our sample consists of State-Owned Banks (SOBs), Joint-Stock Banks (JSBs), major City-Commercial Banks (CCBs) and other Credit Cooperatives. All of the data are collected from the Almanac of China's Finance and Banking, which is the official publication of the People's Bank of China. We use the total number of ATM machines (or POS terminals) to proxy the adoption level of ATMs (and POSs) in the market. They are the dependent variables in the estimation.

As for the determinants of the diffusion of non-cash payment, there are several explanatory variables involved in the empirical framework. Hannan and McDowell (1984) and Carbó-Valverde and Rodriguez-Fernández (2008) find that the intensity of adoption is mainly driven by rivals' precedence, network effects and market power. In our research work, we define these explanatory variables as follows:

Rival's precedence
One period lag of other banks' adoption of ATMs (and POSs) is used to proxy the rival's precedence. Because the rivals' adoption of a new innovation may affect the marketing strategies of its counterparts in the industry, a positive sign is expected. Log transformation are used to reduce heteroscedasticity concerns.

Own and indirect network effects
We employ the product of (*card growth × own ATMs*) and (*card growth × own POSs*) to proxy the direct ATM and POS network effects. This reflects the bank's own non-cash payment infrastructure level. Additionally, the products of (*own card growth × competitor's ATMs*) and (*own card growth × competitor's POSs*) are used to proxy the indirect ATM and POS network effects. It reflects other banks' infrastructure levels. After the initial investment in non-cash payment infrastructure, the bank tends to take returns and weaken its efforts to improve the existing network. On the other hand, a better payment environment of the counterparts may force a bank to improve its own payment network. Therefore, we expect negative signs for the direct network variables and positive signs for indirect network variables.

Market Concentration
We use the Hirfindahl-Hirschman Index (HHI) to proxy the market concentration in both ATM and POS markets. According to the industrial organization theory, the financial institutions with higher market share have more advantages to reduce the variable costs and promote the diffusion of an innovation. Hence, a concentrated market structure is beneficial for this diffusion. Therefore, a positive sign for market concentration is expected.

Control variables:
We lastly carefully select control variables to ensure that the estimation is robust to the omitted variables. *Cards* is the total number of annual bank cards issued; *Merchants* is the total number of merchants recruited that provide POS service to customers; *Branches* is the number of an individual bank's branches; *Balance* is the volume of bank card balances. In addition, we use the log transformation of variables to reduce heteroscedasticity. The growth of ATMs (or POSs) is the annual growth rate of ATM machines (and POS terminals) in the market. It reflects the infrastructure improvement of the non-cash payment network.

5 Results

5.1 The diffusion rates of ATM and POS transactions

The diffusion patterns of ATMs and POS in the Chinese market are shown in Table 3. Using both exponential and Gompertz curves, the ATM and POS diffusion rates are measured by the coefficient β. The values of β of POS in the Gompertz estimations are higher than those of ATMs. It implies that, in general, the POS terminals have shown a higher diffusion rate than ATMs.[4] This result is consistent with the statistical observations that the number of POS terminals has increased faster than ATM machines, as shown in Figure 1. Compared with an ATM machine, a POS terminal needs relatively lower installation and maintenance expenses. Therefore, POS terminals are more accessible and easily accepted by acquiring banks and merchants. This also accounts for the higher growth rate of POS terminals than ATM machines, as shown in Figure 1.[5] This result is also robust when a time trend is interacted with other variables, which are rivals' precedence, own effects and indirect effects. In addition, the interactive variables are found to have lower diffusion rates than the original time effect for both ATM and POS terminals during our research period.

China *UnionPay* is the nation's largest electronic payment network and bankcard association, with the obligation to expand and enhance non-cash payments in China. The results of ATM and POS diffusion patterns after 2002, when UnionPay was established, are shown in Table 4. It is not surprising that, the diffusion rates of both ATM and POS transactions after 2002 became higher than the average level. This result is also consistent when the interactive variables are taken into account. By means of better infrastructure and a countrywide switching network and service centers, *UnionPay* promotes the inter-regional and inter-bank usage of payment cards.[6] Meanwhile, a unified brand has improved the acceptance of both merchants and customers. Consequently, we argue that the foundation of *UnionPay* has promoted the adoption and diffusion level of non-cash payment instruments. Next, similar to the previous evidence, POS has shown a higher diffusion rate than ATM machines. It is robust when the interactive variables of rival precedence and indirect effects are considered. In addition, the gap in the diffusion rate between the ATM and POS transaction values became smaller. It implies the growth pattern of ATM and POS seems to converge to each other. ATM machines increase faster than that of POS terminals after the establishment of *UnionPay* in 2002. The latter could be explained by the improvement of inter-regional and inter-bank withdrawal functions of the ATM network. On the other hand, the business quarrel for the interchange fee among merchants, card issuing banks and card acquiring banks has impeded the further diffusion of POS terminals.

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[4] The results of exponential and Gempertz curves are not consistent. The Gompertz model has more advantages in estimating the innovation adoption at different speed. It is more flexible than the linear-transformed logistic curve because it is asymmetric and allows for different curvatures in different phases (Snellman et al. 2000). Therefore, we tend to accept the results using a Gompertz curve.

[5] However, the adoption of POS payments is impeded by a complex interchange fee mechanism. The actual utilization rate of POS is far lower than that of ATM machines. It also accounts for the higher transaction volume of ATM withdrawal than the consumption with POS, as shown in Figure 2.

[6] It aims at enabling the cardholders to withdraw cash from any bank's ATM machine in any city. Another objective of uniformed payment brand is to compete with foreign banks and card organizations under the WTO agreement. (Worthington 2003 & 2005)

5.2 The determinants of ATM and POS diffusions

Table 5 shows the determinants of ATM and POS diffusion rates. The bank-level β from the Gompertz curve is employed as the dependent variable. The explanatory variables are also the mean values of each individual bank. Our results suggest that the diffusion rate of ATMs is mainly driven by rivals' adoption and the infrastructure of card payments. This result is consistent with the previous work on mature payment market (Carbó-Valverde and Rodríguez-Fernández 2008). The growth of both ATMs and POS terminals has boosted the ATM diffusion rate. The improvement of the infrastructure is a significant factor to drive the adoption of ATMs and POSs in the growth stage of the non-cash payment market. We find some interesting results on the diffusion rate of POS terminals. The direct POS network has a positive and significant effect on the diffusion rate of POS terminals. However, POS diffusion reacted negatively to the direct ATM network effect. The latter implies a strong substitution effect of ATM withdrawals on POS payments. The card payments in POS terminals are still dominated by cash withdrawal in the Chinese market. On the other hand, the majority of payment cards in China are debit cards rather than credit cards.[7] Worthington (2005) explained the higher growth rate of debit cards over credit cards with both supply and demand factors and explained it as a phenomenon of the culture of saving and spending. In addition, the fast diffusion rate of debit cards is also attributed to the little risk for banks because since no credit is attached to the transaction. Customers prefer to pay with their account balance instead of a credit line.[8] Therefore, higher balance levels account for the significant effect of *balance* on the POS diffusion rate.

The Herfindahl–Hirschman Index exerted a positive impact on POS diffusion. It suggests that the market concentration promotes the diffusion rate of POS terminals. This result is consistent with the view that a concentrated market can facilitate the diffusion of a new technology (Hannan and McDowell 1984). However, both ATM and POS markets in China have experienced a change from concentrated to moderately concentrated markets between 1996 and 2005 (see Table 2), and the diffusion rate of POS is slowing down during this period. Carbó-Valverde and Rodriguez-Fernández (2008) used the Lerner Index to measure market power, finding that market power has a negative effect on ATM diffusion but a positive impact on the POS diffusion rate. The authors argue that the increasing margins of ATMs will increase the annual fees of cardholders, but this seems to not hold true for POS transactions. This result is also confirmed by the effect of recruited merchants. However, it is inconsistent with the traditional innovation theory, which says that the acceptance of merchants and

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[7] The People's bank of China has reported that, until the end of 2011, the accumulated number of credit card issuance was 285 million, which accounts for only 9.66 percent of total payment cards in the Chinese market. The ratio of debit cards to credit cards is 9.33:1.

[8] Worthington (2005) also points out that the informal channel of borrowing with low or even no interest is more accepted by Chinese consumers. Credit lines, however, are not preferred by Chinese customers.

customers is the main drivers to promote the improvement of infrastructure during the expansion stage. This result could be explained by the interchange fee barrier, which is the major bottleneck for the diffusion of POS terminals in the Chinese payment market.[9] POS payments are not preferred by merchants because of their higher transaction costs. It also accounts for the negative impact of merchants on the diffusion of POS terminals.

6 Conclusions and policy implications

In this study, we study the diffusion patterns of non-cash payments in the Chinese market. Based on both exponential and Gompertz curves, we find that POS terminals have shown a higher diffusion rate than ATMs. This result is also robust when a time trend is interacted with rivals' precedence, own effects, indirect effects and market concentration. The diffusion rates of both ATM and POS transactions have accelerated after 2002, when China *UnionPay* was established. Therefore, we argue that the establishment of China *UnionPay* has promoted the expansion of non-cash payments. The diffusion rate of ATM is mainly driven by the rivals' adoption and infrastructure. The market concentration, infrastructure development, direct network effects and balance promote the diffusion rate of POS terminals. We find a negative impact of direct ATM network on POS diffusion, which implies a substitution effect of ATM withdrawals on POS payments. Interestingly, we document a negative impact of merchants recruited that provide POS transaction services on the diffusion of POS terminals. This result implies that in spite of the increasing number of POS terminals, the diffusion rate of POS is somehow impeded by the interchange fee mechanism.

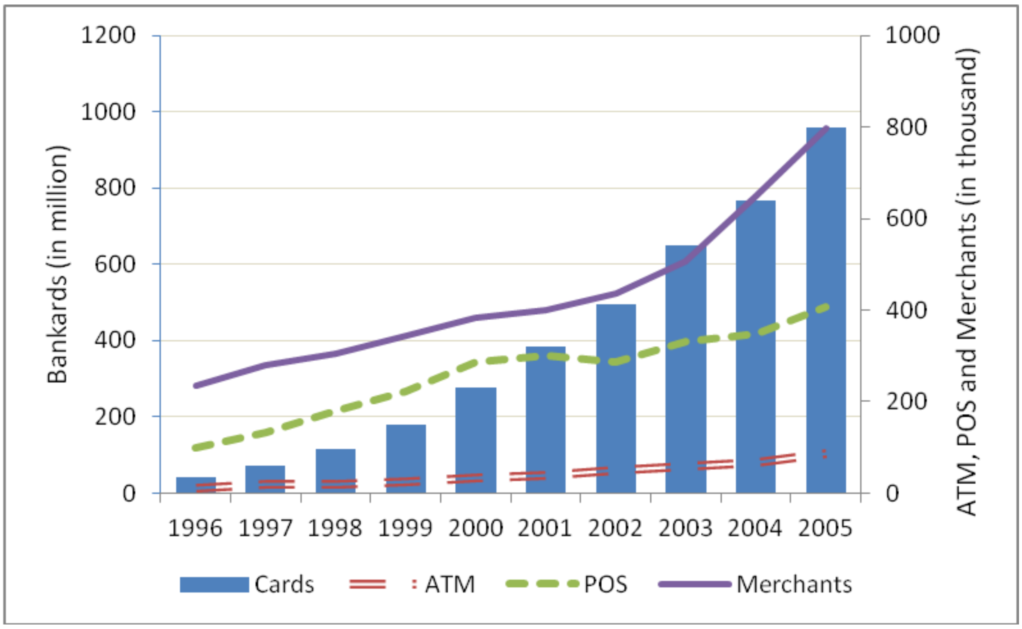
Our investigations also have policy implications which are twofold. The current problem of the non-cash payment system in China is first the lagging development of credit cards rather than debit cards. The potential financial defaults of cardholders have impeded the adoption and diffusion of card payments (Worthington et al. 2011). Therefore, it is necessary to establish an effective Personal Credit Management mechanism to generate a good screening tool and a safer payment environment for credit cards. Second, considering the high and inelastic interchange fee, merchants are reluctant to adopt the innovation of non-cash payments instruments. Hence, the regulator should formulate an efficient pricing mechanism to attract more merchants into the payment network. It contributes to the sustainable development of the whole non-cash payment industry. In terms of future research, this investigation represents a first step on how and to what extent non-cash payments can be accepted in China. However, it is valuable to study further diffusion patterns for other payment media such as mobile payments as they evolve. It would also be interesting

[9] Many recruited merchants in Shanghai, Guangzhou and other major cities have complained about the higher interchange fee of POS. Some merchants have even stopped the POS payment service.

to link the evolution of payment patterns to demographic changes in the country provided that these data are available.

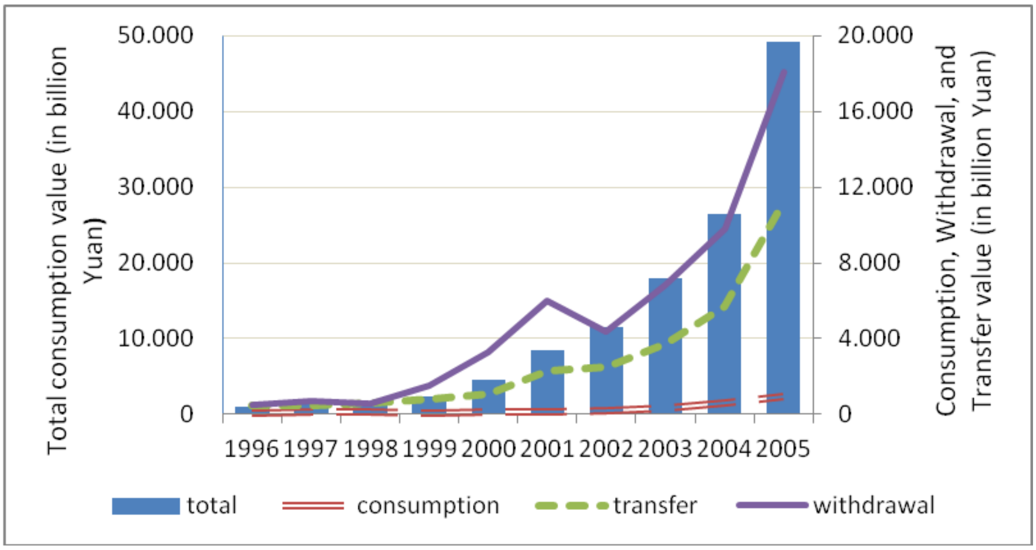
Appendix

Figure 1: The infrastructure of non-cash payments



Data source: Almanac of China's Finance and Banking.

Figure 2: The transaction value of non-cash payments



Data source: Almanac of China's Finance and Banking.

Table 1: Summary statistics of the variables

Variable	Mean	Std. Dev	Min	Max
Cards	13.68	2.44	3.33	19.20
Consumption	9.93	3.07	1.10	16.97
Withdrawal	13.25	2.75	0.69	20.47
Transfer	11.97	3.79	1.44	19.95
ATM	4.79	2.18	0.69	11.97
POS	5.97	2.61	1.10	11.51
Merchants	5.84	3.01	0.69	11.97
Balance	11.85	2.39	0.69	17.80
Branches	5.57	2.10	2.56	10.66

Note: all variables are log-transformed.

Table 2: Yearly Hirfindahl-Hirschman Indices (HHI) in both ATM and POS markets

	HHI	
Year	ATM	POS
1996	2,817	2,425
1997	2,523	2,802
1998	2,123	2,266
1999	1,922	1,851
2000	1,811	1,677
2001	1,619	1,416
2002	1,454	1,652
2003	1,358	1,602
2004	1,280	1,616
2005	1,295	1,674

Table 3: The diffusion pattern of ATM and POS terminals, 1996-2005.

	Diffusion of ATMs		Diffusion of POS terminals	
	Logistic	**Gompertz**	**Logistic**	**Gompertz**
α	2.1445***	-0.3599	3.8309***	0.3498
	(18.14)	(-1.41)	(20.51)	(0.38)
β (Time)	0.2987***	0.1232***	0.2553***	0.1857***
	(19.70)	(3.84)	(10.58)	(4.32)
Number of Observations	433	276	370	180
α	3.1810***	-0.0437	4.5513***	0.6600
	(22.71)	(-0.15)	(16.35)	(1.50)
β (Time * rivals' precedence)	0.0507***	0.0385***	0.0392***	0.0400***
	(02.29)	(4.49)	(6.26)	(3.98)
Number of Observations	319	276	273	180
α	3.4662***	-0.7292***	4.5810***	-0.1585
	(64.54)	(-3.99)	(33.63)	(-0.62)
β (Time * Own effect)	0.1186***	0.0499***	0.1176***	0.0664***
	(26.21)	(3.37)	(11.82)	(3.72)
Number of Observations	331	276	289	180
α	2.4459***	-0.4999**	4.1115***	0.1298
	(24.08)	(-2.28)	(24.90)	(0.45)
β (Time * Indirect effects)	0.0313***	0.0126***	0.0261***	0.0187***
	(20.05)	(3.84)	(10.32)	(4.24)
Number of Observations	433	276	370	180
α	1.0969***	0.1742***	3.8253***	0.3240
	(6.04)	(14.07)	(18.57)	(0.90)
β (Time *HHI)	0.00031***	0.00014***	0.00016***	0.00011***
	(18.49)	(3.72)	(9.59)	(3.93)
Number of Observations	433	276	370	180

Note: A panel-data approach with fixed effects is employed for these estimations.
t statistics in parentheses * p<0.10, ** p<0.05, *** p<0.01.

Table 4: The diffusion pattern of ATM and POS terminals after the foundation of China-Union-Pay (CUP) in 2002.

	Diffusion of ATMs		Diffusion of POS terminals	
	Logistic	**Gompertz**	**Logistic**	**Gompertz**
α	1.4422***	1.0164***	3.2637***	1.6402
	(5.43)	(1.15)	(6.53)	(1.42)
β (Time)	0.3071***	0.2585**	0.2248***	0.2992**
	(10.41)	(2.62)	(4.08)	(2.34)
Number of Observations	263	191	221	116
α	2.8261***	0.0719	4.5660***	1.1357
	(17.02)	(0.14)	(10.98)	(1.19)
β (Time * rivals' precedence)	0.0440***	0.0393***	0.0219**	0.0469**
	(9.31)	(2.68)	(2.48)	(2.30)
Number of Observations	227	191	184	116
α	2.3485***	-0.7672	2.8497***	-0.2611
	(25.00)	(-1.36)	(13.66)	(-0.35)
β (Time * Own effect)	0.1592***	0.0407	0.1783***	0.0515
	(20.96)	(0.95)	(12.54)	(1.09)
Number of Observations	238	191	198	116
α	1.5635***	0.9699	3.5341***	1.3737***
	(6.40)	(1.19)	(7.93)	(53.63)
β (Time * Indirect effects)	0.0347***	0.0301***	0.0228***	0.0315**
	(10.81)	(2.76)	(3.97)	(2.37)
Number of Observations	263	191	221	116
α	0.9301***	1.0877	3.6031***	1.0711
	(2.70)	(0.97)	(8.66)	(1.11)
β (Time *HHI)	0.00028***	0.00020**	0.00011***	0.000144**
	(9.51)	(2.13)	(4.09)	(2.22)
Number of Observations	263	191	221	116

Note: A panel-data approach with fixed effects is employed for these estimation.
t statistics in parentheses * p<0.10, ** p<0.05, *** p<0.01.

Table 5: The determinants of ATM and POS diffusions.

	*Beta*_ATM	*Beta*_POS
Rivals' ATM adoption$_{t-1}$	2.111**	-
	(2.03)	-
Rivals' POS adoption$_{t-1}$	-	0.0394
	-	(0.04)
HHI ATM network	0.00024	-
	(0.08)	
HHI POS network	-	0.0059*
	-	(1.84)
Log[Card growth * Own ATMs]	-0.192	-0.322**
	(-1.21)	(-1.85)
Log[Card growth * Own POSs]	-0.432	1.920**
	(-0.72)	(2.36)
Log[Own card * Competitor's ATMs]	0.002	0.0021
	(1.65)	(0.79)
Log[Own card * Competitor's POSs]	8.91E-5	-3.36E-5
	(0.12)	(0.21)
Growth of ATMs	1.882***	1.636**
	(3.34)	(2.74)
Growth of POSs	0.822*	0.189
	(1.99)	(0.38)
Balance	0.117	0.271*
	(0.97)	(1.96)
Branches	0.086	-
	(0.60)	-
Merchants	-	-0.341**
	-	(-2.19)
Constant	-18.74***	-11.91*
	(-3.53)	(-1.74)
N	52	42
F-test	3.38***	1.86*
R-sq	0.45	0.37

Note: The Beta is estimated for each individual bank in the sample. All explanatory variables are the mean values of each individual bank as well. *t-statistic* in parentheses * $p<0.10$, ** $p<0.05$, *** $p<0.01$

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