AEA Papers and Proceedings 2019, 109: 48–53
https://doi.org/10.1257/pandp.20191010

THE IMPACT OF DIGITAL ECONOMY[‡]

Mobile Wallet and Entrepreneurial Growth[†]

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With the rapid development of smartphone and financial technology, mobile payment has been growing fast in recent years. The total transaction value worldwide through mobile wallet payments has exceeded US$350 billion by 2017 and expects to grow at an annual rate of 39 percent to over 1.6 trillion by 2022 (Statista 2018).

Compared with other payment methods, mobile wallet can settle consumers' payments, both to other consumers and to merchants, with lower cost and greater efficiency. The high smartphone penetration (e.g., 72 percent in the United States) provides the infrastructure allowing consumers to make cashless payments almost anywhere (so long as they carry their mobile phones). While it is easy to see mobile payment's critical role in facilitating transactions in developing countries where card-payment arrangements are not widespread, it is interesting that even in developed countries, where credit and debit cards are prevalent, consumers welcome the added convenience, as witnessed by the rapid growth in the mobile wallet transaction volume (Capgemini and BNP Paribas 2017). A natural question arises, then, on the incremental benefit of mobile wallet as a new payment technology. How does the introduction of mobile-payment technology affect the economy?

On the one hand, mobile wallet improves shopping efficiency by reducing transaction frictions, leading to a spending increase. On the other hand, it is not obvious whether the economic gains from mobile-payment technology are sufficiently large relative to other cashless payment technologies (e.g., bank cards). Indeed, there may merely be substitution between payment methods. A large fraction of mobile wallet transactions to date only serves to facilitate consumer-to-consumer funds transfer as opposed to consumer-to-merchant payment.

This paper approaches these questions by investigating business sales after the introduction of a new mobile-payment technology. With a proprietary dataset on mobile wallet and bank card transactions from a representative sample of 25,000 customers of a leading bank in Singapore, we observe a significant increase in the use of mobile wallet after the technology introduction. At the same time, the aggregate level of ATM cash withdrawal remains stable. More surprisingly, and in support of an increase in spending after the introduction of a mobile-payment technology, debit and credit card sales grow (by around 3.5 percent per month), especially for small and entrepreneurial firms.

A plausible explanation for the card-spending increase is that the new mobile-payment technology reduces transaction frictions by shortening transaction time. The improved shopping experience could promote demand, leading to a genuine increase in consumer spending. To test this hypothesis, we investigate the source of the card-sales growth. We find corroborative

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[†]Go to https://doi.org/10.1257/pandp.20191010 to visit the article page for additional materials and author disclosure statement(s).

evidence, based on card-transaction records, that small and new merchants attract more new customers after the technology is introduced. The card-sales growth does not merely reflect a change in payment behavior by existing customers, rather the improved payment convenience generates additional demand by driving retail traffic (to new stores).

I. Methodology

Despite a strong banking system, 60 percent of Singapore's daily off-line transactions are still paid in cash by 2015 (KPMG 2016). The preference toward cash, however, is not unique for Singapore. By 2010s, the value of currency in circulation for developed regions is around 10 percent of the GDP (Rogoff 2014); 60 percent of North American consumers remain frequent cash users (Accenture Consulting 2016).

Starting from 2017, Singapore has been working hard to move toward a cashless society, and the fast development in mobile payments plays a critical role. On April 13, 2017, Singapore has first introduced the use of the Quick Response (QR) code payment function in the mobile wallet. This new technology enables all users to receive and make immediate payments by generating their own QR code on the mobile phone app. Buyers and sellers of goods and services can complete the transaction by displaying or scanning QR codes. The technology not only brings added convenience to consumers given the large smartphone ownership, but also reduces the transaction costs especially for small and new businesses. Compared to the existing card-payment system, the QR code-payment technology allows for more efficient payments through immediate settlement, lower transaction costs, and enhanced security.

We base our study on a large panel of dataset containing a variety of bank activities for 250,000 Singapore consumers from a leading local bank during 2016:1 to 2017:12. In this dataset, we observe mobile wallet transactions for the 250,000 customers. Meanwhile, we have data on all the debit card, credit card, and ATM transactions in this bank for them (see detailed description of the bank data in the online Appendix and Agarwal and Qian 2014, 2017; Agarwal, Qian, and Zou 2017).

We aggregate all the mobile wallet transaction counts and amounts in 2017 at monthly frequency to directly check the effect of QR code-payment technology in mobile wallet usage. We further investigate whether the enhanced efficiency from mobile wallet payment brings positive externality to card-payment transactions, which is by far the dominant cashless payment instrument in Singapore.

Our empirical identification strategy relies on the differential benefits of the improved payment efficiency across merchants: the enhanced transaction efficiency from QR code payment will move customer traffic and raise their effective demand mostly for small shops and new shops. We manually correct merchant names in card-transaction records and require all the local off-line merchants in our final sample to have active sales in both 2016 (i.e., the benchmark period used to assign merchants as small or large) and 2017 (i.e., the estimation period). In our final sample, 16,479 off-line merchants are included. Among them, we define merchants with median monthly card sales lower than the within-merchant-category median in 2016 as *small merchants* and the rest as large merchants. We also define merchants with sales record only starting in the second half of 2016 as *new merchants*.

II. Results

A. *Direct Effect on Mobile Wallet Usage*

We observe a significant increase in mobile wallet usage from Singapore consumers after the QR code-payment introduction. For both the transaction amount and transaction counts shown in Figure 1, the mobile wallet transactions stay relatively flat before April 2017. Upon the introduction of new QR code-payment technology, the monthly transaction amount and count start to trend up almost immediately. In contrast, the ATM monthly withdrawals stay rather stable throughout the year, suggesting that the rise of mobile wallet transactions is not simply driven by a reduction in cash usage.

As the QR code-payment technology mainly makes small-size payments more convenient, which were typically completed by cash before (Cohen and Rysman 2013, Wang and Wolman 2016), we should see strong increase in the small-size transactions. In Figure 2, we divide all mobile wallet transactions into two groups by the threshold size per transaction of SGD

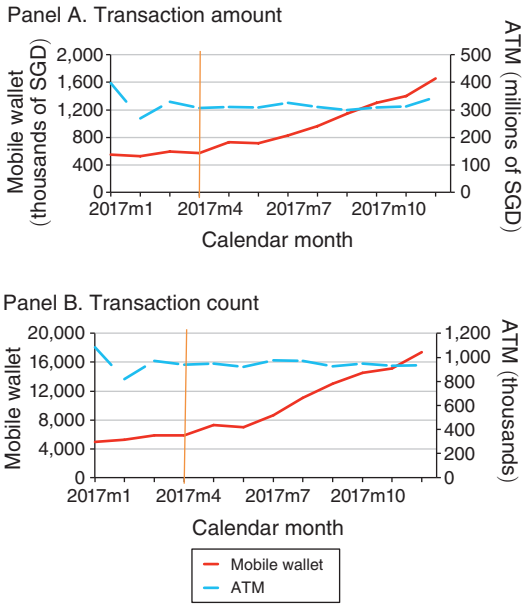

FIGURE 1. TIME TREND OF MOBILE WALLET AND ATM TRANSACTIONS

Note: This figure plots the time trends for mobile wallet and ATM transactions in 2017.

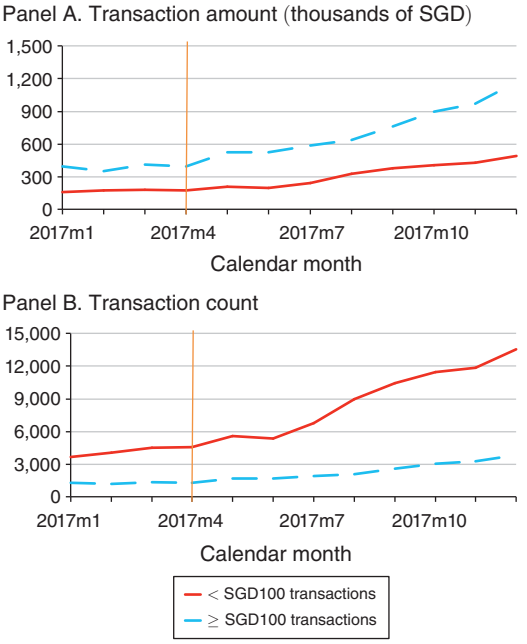

FIGURE 2. TIME TREND OF SMALL-SIZE VERSUS LARGE-SIZE MOBILE WALLET TRANSACTIONS

Note: This figure plots the time trends for small-size (i.e., transaction size $<$ SGD100) versus large-size (i.e., transaction size $\geq$ SGD100) mobile wallet transactions in 2017.

100 and plot the time trend accordingly. From the transaction amount perspective, large-size transactions increase more than the small-size ones. However, the trend in transaction counts shows clearly that the increase in the number of small-size transactions greatly outnumbers that of large-size ones, suggesting that the increase in the large-size transaction amount is driven by the transaction size instead of transaction frequency. In summary, there is compelling direct evidence that consumers indeed respond to the new payment technology by using the mobile wallet more frequently, especially for the small-size transactions. (See online Appendix Table A1 for *t*-test results).

B. *Card-Sales Response*

We then explore whether the improved payment efficiency from mobile wallet spills over to merchants' card sales. We compare the response of small merchants' card sales to the introduction of QR code-payment technology with that from large merchants in a difference-in-difference setting. With the dependent variable being the monthly log of card-sales amount or sales count for each merchant, the key explanatory variable in the regression is the interaction between a dummy variable *small merchant* and an indicator variable *post*. *Post* is equal to one for the nine months *on and after* the technology shock. We include the interaction between *small merchant* and an indicator variable *pre* equal to one for the one month *before* the technology shock to show parallel trend. We include merchant and year-month fixed effects to control for unobserved characteristics varied across merchants and time. Standard errors are clustered at the merchant level.

The small merchants experience an average increase of 3.5 percent in the amount of monthly card sales, relative to their larger counterparts, during the nine-month period after the QR code-payment technology shock (Table 1). The increase in card-sales count is around 3.4 percent as reported in column 2. The effects are both statistically and economically significant. Moreover, the close-to-zero pre-trend

Table 1—Average Card-Sale Response

	log(total sales amount) (1)	log(total sales count) (2)
Small merchant × pre	−0.008	−0.000
	(0.019)	(0.012)
Small merchant × post	0.034	0.033
	(0.014)	(0.010)
Constant	6.884	1.898
	(0.008)	(0.005)
Fixed effects	Merchant, year-month	
Observations	148,460	
R^2	0.81	0.91

Notes: This table shows the average card-sale response of small merchants compared with large merchants to the first QR code-payment introduction in the period from 2017:1 to 2017:12. The dependent variable is the log of monthly *total sales amount* for each merchant in column 1, and the log of monthly *total sales count* for each merchant in column 2. Standard errors clustered at merchant level are reported in parentheses under the coefficient estimates.

Table 2—Response of New Entrepreneurs

	log(total sales amount) (1)	log(total sales count) (2)
Small merchant × pre	−0.008	−0.001
	(0.019)	(0.012)
Small merchant × post	0.021	0.020
	(0.014)	(0.010)
Small merchant × new merchant × post	0.083	0.077
	(0.026)	(0.020)
Constant	6.884	1.898
	(0.008)	(0.005)
Fixed effects	Merchant, year-month	
Observations	148,460	
R^2	0.81	0.91

Notes: This table reports the heterogeneity in the average card-sale response by the stage of the merchant business. *New merchant* is a dummy variable equal to one for the merchants with the first sale occuring in the later half year of 2016 (i.e., later than 2016:6). The dependent variable is the log of monthly *total sales amount* for each merchant in column 1, and the log of monthly *total sales count* for each merchant in column 2. Standard errors clustered at merchant level are reported in parentheses under the coefficient estimates.

estimates corroborate that the differences in card-sale changes are attributable to the new QR payment technology. The effect starts in the first quarter after the technology is introduced and persists afterward (see online Appendix Figure A1).

As the marginal benefit from enhanced payment efficiency should be larger for small purchases, we expect small-size transactions to exhibit a stronger increase in card sales, especially for smaller merchants. Indeed, we find consistent evidence (see online Appendix Table A2).

C. *New Businesses Drive Sales Growth*

Gains from the mobile-payment technology are likely to be greater for new businesses. They tend to run on a smaller scale therefore enjoy a higher marginal benefit from reduced transaction cost and improved transaction efficiency. In addition, new merchants possess a less stable customer base and thus will receive a greater benefit from an increase in consumer traffic. Evidence on sales increases in card transactions adds credence to the argument.

We proxy a merchant's stage of business by the time of its first sale in 2016. The merchants, which generated first sale in the second half of 2016 (i.e., during 2016:7–2016:12), are classified as *new merchants*, and the rest as old merchants. As reported in Table 2, although the small old merchants increase around 2.1 percent (2.0 percent) in card-sales amount (count) relative to large merchants after the technology shock, the rise of card-sales amount (count) for small new merchants are 8.7 percent (8.0 percent) higher than the relatively older ones, suggesting that new firms benefit the most from the spending increase after the introduction of mobile-payment technology.

D. *Economic Mechanism: New Customer Acquisition*

The differential change in card sales could be attributed to two mechanisms. The observed card-spending increase could reflect a change in consumers' payment choice and the overall spending stays the same. Or, the new payment technology stimulates demand through a lower transaction-cost channel: consumers on average wait less for payment and do not need to stock up cash before shopping.

We differentiate the two mechanisms by investigating the source of the card-sales growth.

The substitution channel implies no change in consumer composition. However, an improved shopping experience, as a result of lower transaction costs, can drive retail traffic and boost spending—consumers are more likely to explore shopping in new areas.

For each merchant, we define the customers from a new postal sector (measured by the two-digit postal code of residence) as new customers, where a new postal sector is the one which never produces any sale to that merchant in the whole year of 2016. In Table 3, we investigate the change in the fraction of new customers count and the fraction of new customer-sale amount and count after the technology is introduced. Relative to large merchants, the fraction of new customer counts, sales amount and sales count all increase by 1.8 percent for the small merchants (p-value < 0.001). The effect is economically significant. Given an average fraction of new customer count (and new customer sales) of around 28 percent, this translates into an increase of more than 6 percent in new customer-count fraction (and new customer-sales fraction). This result suggests that the additional card-sales growth reflects genuine business growth.

Table 3—Response of New Customer Sales

	Fraction of new customer		
	Count (1)	Sales amount (2)	Sales count (3)
Small merchant × post	0.018	0.017	0.017
	(0.004)	(0.004)	(0.004)
Constant	0.281	0.278	0.276
	(0.002)	(0.003)	(0.002)
Fixed effects	Merchant, year-month		
Observations	148,460		
R^2	0.59	0.55	0.59

Notes: This table reports the response of sales from customers in new postal areas. Dependent variables are new customer-count fraction, new customer-sales-amount fraction, and new customer-sales-count fraction in columns 1–3, respectively. The new postal area is defined as the postal area that doesn't produce any sale for a merchant in 2016, but produces sale in 2017. Standard errors clustered at merchant level are reported in parentheses under the coefficient estimates.

III. Conclusion

This paper investigates how the introduction of mobile-payment technology affects the economy. Using a novel dataset on bank cards and mobile wallet transactions from 250,000 Singapore consumers, we first confirm that upon introduction of QR code mobile-payment technology, the mobile wallet usage immediately trends up, with small-size transactions leading the usage increase.

The enhanced transaction efficiency from QR code payment has a significant spillover effect on card spending. We find that card sales for small merchants increased by 3.5 percent more than for the large merchants after the QR code-payment technology shock. New entrepreneurs who just started their business benefit more from the new technology. The attraction of new customer purchases for small merchants suggests a genuine business growth instead of substitution from cash to card payment (among existing customers).

Overall, our work contributes to the FinTech and digitization literatures on cashless payment by providing novel insights on the real effect of improved payment efficiency (Agarwal et al. 2018, Bachas et al. 2018). We show that the enhanced convenience in mobile wallet payment fosters business growth, especially for new and small firms.

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