Internet Appendix to "Physical Frictions and Digital Banking Adoption"*

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Abstract

A behavioral literature suggests that minor frictions can elicit desirable behavior without obvious coercion. Using closures of ATMs in a densely populated city as an instrument for small frictions to physical banking access, we find that customers affected by ATM closures increase their usage of the bank's digital platform. Other spillover effects of this adoption of financial technology include increases in point-of-sale (POS) transactions, electronic funds transfers, automatic bill payments and savings, and a reduction in cash usage. Our results show that minor frictions can help overcome the status-quo bias and facilitate significant behavior change.

Keywords: Frictions; Digital Banking; FinTech; Geography; Household Finance; Financial Inclusion

JEL Classification Codes: D12, D14, G21, G40, O33

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1. Summary

This Internet Appendix tables the results from additional tests described but not reported in the paper "Physical Frictions and Digital Banking Adoption" by Choi and Loh (2023).

The first section contains results from tests in the robustness tests section of the paper. The second section reports results from tests that are described in the footnotes of the paper.

2. Results reported in Robustness Tests Section

In Section 5 of the paper, we discuss several additional results and robustness tests. Not all of those results are tabled in the paper. We table the unreported results in this section.

2.1. Subsamples by Time, Location-type, or Salary

The first three tables report our main results re-estimated on subsamples. Table A1 uses subsamples based on the fraction of a customer's past ATM transactions that occur during working hours. We define working hours as 8AM to 6PM on non public-holiday weekdays, and all other days and times are considered non-working hours. The conjecture is that working-hour times are more costly for customers and hence frictions to ATM access might have more of an impact in inducing greater digital banking activity. We find that our results that ATM closures induce more digital banking are significant in both groups but indeed look stronger for the customers in the higher working-hours fraction group. This shows that closure-affected customers who usually access ATMs during working hours face a greater ATM closure friction which induces them more towards digital banking.

Second, Table A2 looks at ATM closures according to the type of location. 11 of the 109 closures are classified as shopping mall locations and the majority of the remainder are ATMs closures at business building locations. We see that the relation between ATM closures and digital banking behavior is strong and significant for closures at both types of locations. Shopping mall closures, although there are only a small number of them, seem to induce a slightly greater impact compared to the business location closures.

Third, in Table A3, we use the median salary to separate the sample into two groups. Presumably, those with above-median salaries will have a higher opportunity cost of time, so it might benefit them more to increase their use of the digital platform to harness the time saved by digital banking. However, if learning requires an upfront time investment, those with a higher opportunity cost of time might be less willing to invest the time. We show that our results are not driven by any one group as the coefficients are significant and do not look very different in both groups.

Overall, the subsample analyses in the paper and in this appendix here allow us to characterize the settings where our results appear stronger—younger customers, working-hours ATM users, and in shopping mall locations.

2.2. Stacked Difference-in-Difference Sample

As an alternative to our panel regression approach, we construct a stacked difference-in-difference sample following the methodology of Gormley and Matsa (2011). For each of the 36 months in our three-year sample, we construct a cohort of treated and untreated customers using customer-month observations (when available) for the six months before and the 12 months after the closure event. Treated customers are those who have experienced either a favorite ATM or a nearest ATM closure that month. Untreated customers for the cohort are those who did not experience any closures in the sample.*Post Closure* is defined as a dummy variable that equals one from event-month 0 to 12 for a customer in the cohort who experienced an ATM closure, and zero otherwise. We then stack the cohorts from the different closure months and estimate the impact of closures on our digital banking outcome variables on the resulting stacked panel. We include calendar month fixed effects and customer fixed effects by cohorts. We then estimate a reduced-form model with digital banking activity regressed on the *Post Closure* dummy.

Table A4 shows that our conclusions are robust to this alternative specification. The friction from ATM closures continues to be positively associated with post-closure digital banking activity.

2.3. Cluster-Based Distance Measure

Our main results are based on the *Distance to ATM* measure which is defined as the average usage distance between the customer's reported address to the bank and the used ATMs. This ignores the possibility that a customer might anchor not only on their reported address (which we assume to be their home), but also on their workplace or a favorite mall. As described in Section 3, we compute an alternative distance measure which includes up to three new "addresses" for each customer by clustering their ATM usage and choosing the top three (based on frequency) cluster centers as additional location anchors. These three new addresses will very likely include their workplace and an additional two other favorite locations. The new *Distance to ATM (Clustered)* measure, which relies on the minimum distance between the ATM and any of these three new anchors or the home address, has a mean of of about 2km (reported in Table 1) instead of a mean of about 5km for the original *Distance to ATM* measure.

In Table A5, when we regress this new clustered distance measure on both ATM closure shocks, we get a coefficient of 0.085 for the *Post Closure (Favorite ATM)* dummy, and a coefficient of 0.061 for the *Post Closure (Nearest ATM)* dummy. It is not surprising that the increase in the distance, 61–85 meters, is smaller than what it was for the baseline distance measure because we are allowing more location anchors for the customer.

Importantly, when we use this new distance measure for our tests on the impact of ATM closures on digital banking, our results are still robust. Table A6 shows that digital banking activity goes up because of the distance friction induced by the closure of the ATM. Hence, we believe our results are unlikely to be sensitive to the lack of a workplace address in our baseline sample.

3. Results Reported in the Footnotes

This section tables the results of tests in the paper that are discussed in the footnotes, in the chronology that they appear in the paper.

3.1. Dropping Movers from the Sample

The bank provided three January snapshots of the customer's mailing postal code. If a customer's address is not the same for all three snapshots, this indicates that they moved during the sample period. Because we do not observe the actual month of move, there is noise in the assumed customer location in the non-January months around the move. We check the robustness of our main results when we drop all movers from the sample.

Table A7 reports these results and shows that our findings are not affected. ATM closures, instrumented by ATM usage distance from customers who had the same address during the sample period, continue to induce an increase in digital banking activity.

3.2. Restricting Sample only to Customers with a Salary Credit

To be more certain that the customers in our sample are actively using the bank as their main bank, we mandate that they should either have at least one salary credit *or* have at least six auto-debit transactions. Adding customers that have no salary credit but have auto-debit activity helps us to include customers who might not receive regular salary credit but have other forms of income. Since private income is hard to identify unlike an inflow obviously flagged as salary credit, we use the existence of auto-debit transactions to proxy for the account being actively used.

We show that our results are similar if we do not use the second (auto-debit) screen and restrict the sample only to customers who have at least one salary credit in the sample period. Table A8 reports these results.

3.3. Removing the Two Control Variables of Beginning Balance and Monthly Salary

In all our tests, we include two controls of beginning balance and monthly salary. These are useful for the second stage digital banking regressions because time variation in the customer's account balance and monthly salary can in monthly digital banking activity. These two controls appear less important for the regression of distance on ATM closures but need to be included for consistency with the second stage. We show in Table A9 that when we remove these two controls from all the regressions, we get very similar results.

3.4. Using the Two Closure Separately

We estimate our main results using the two closure events separately.

We see in Table A10 that the favorite ATM closure appears to induce larger economic effects than the nearest ATM closure. However, the nearest ATM results have greater statistical reliability. Both types of closures appear important and can on their own induce a substitution effect to digital banking when examined separately.

Hence, our main results include both types of closures.

3.5. Short and Long Temporary Closures

In Table A11, we split the sample of temporary closures based on the median number of days closed (which is 65) and we find that longer-duration temporary closures have stronger results. This shows that very short-duration temporary closures might not introduce sufficient friction to induce a significant substitution to digital banking in the post-closure period. Closures need to be long enough to nudge customers into behavioral change.

3.6. Alternative Outcome Variable: Banking Fees Paid by the Customer

In Table A12, we examine a proxy for banking fees paid by customers using Knittel and Stango (2009)'s price measure of total account fees divided by the account balance. At the customer level, this measure is noisy due to small denominators and we use various levels of winsorization, from 0% to 5%. We see that there is evidence that this measure is lower after ATM closures, consistent with Knittel and Stango (2009)'s finding that ATM network density is positively related to fees, although the coefficient is not statistically significant when outliers are accounted for with greater winsorization. As the bank is unlikely to be closing ATMs for the purpose of reducing the affected customer's fees, we interpret the slight negative effect on fees to be consistent with the avoidance of physical banking fees facilitated by more digital banking.

3.7. Dropping 2017

Agarwal, Qian, Ren, Tsai, and Yeung (2020) suggest that some DBS ATMs were closed in 2017 in response to the introduction of mobile payments technology for merchants. However, their definition of ATM closures is based on the number of machines at the district (large area) level while we identify closures as all machines closing at a particular postal code (i.e., one building). Our closures are more likely to be renovation motivated rather than due to slight adjustments by the bank at postal codes with multiple ATMs.

Nevertheless in Table A13, we show that our results are robust when we drop 2017 from our sample.

References

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Table A1: Main Results Re-estimated on Working-Hour Fraction Subsamples

The customer-month observations in our sample are separated into two groups based on the fraction of a customer's past ATM transactions that occurs during working hours. Working hours are defined as 8AM to 6PM on non public-holiday weekdays, and all other days and times are considered non-working hours. Panel A reports second stage regression estimations from the low working-hour fraction customers and Panel B reports estimations from the high working-hour fraction customers. *Distance to ATM* is the main independent variable (a transaction-weighted usage distance to ATM from the provided customer address, instrumented by the two ATM closure shocks). The dependent variables are log(1+Total # of Digital Transactions, log(1+Total # of Digital Financial Transactions), and log(1+Total S$ Amount of Digital Transactions). Controls include monthly beginning account balance in thousands (Beginning Balance), Monthly Salary in thousands, year-month fixed effects, and customer fixed effects. Coefficient estimates are reported with t-statistics in parentheses based on standard errors clustered by the customer's favorite ATM, with ***, **, and * respectively denoting statistical significance at the 1%, 5%, and 10% levels. The Cragg-Donald Wald F-statistic for the IV is 106.565 in Panel A and 41.528 in Panel B.

Panel A: Subsample of Low Working-Hour Fraction Customers

	(1)	(2)	(3)
	log(1+# of Digital Txns)		log(1+S$ of
Variables	Total	Financial	Digital Txns)
$\widehat{\text{Distance to}}$ ATM	0.157***	0.108***	0.318***
	(4.02)	(4.77)	(4.04)
Beginning Balance	0.0002***	0.0002***	0.001***
	(5.38)	(6.01)	(6.82)
Monthly Salary	0.005***	0.003***	0.014***
	(9.54)	(9.53)	(9.75)
Observations	3,028,208	3,028,208	3,028,208
R-squared	0.784	0.681	0.720
Year-Month FE	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes

Panel B: Subsample of High Working-Hour Fraction Customers

Variables	(1) Total	(2) Financial	(3) log(1+S$ of Digital Txns)
$\widehat{\text{Distance to}}$ ATM	0.305***	0.138***	0.483***
	(4.37)	(4.15)	(3.90)
Beginning Balance	0.0001**	0.0001***	0.001***
	(2.40)	(6.15)	(8.67)
Monthly Salary	0.002***	0.002***	0.009***
	(5.90)	(6.94)	(8.12)
Observations	2,769,703	2,769,703	2,769,703
R-squared	0.643	0.633	0.662
Year-Month FE	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes

Table A2: Main Results Re-Estimated for Shopping Mall and Business Location ATM Closures

Panel A reports the effect of ATM closures at shopping mall locations on digital banking activity where all customers who experienced non-shopping mall ATM closures in the sample period are excluded. Panel B reports the effect of ATM closures at business locations on digital banking activity where customers who experienced non-business ATM closures in the sample period are excluded. Second stage regression estimates use *Distance to ATM* as the main independent variable (a transaction-weighted usage distance to ATM from the provided customer address, instrumented by the two ATM closure shocks). The dependent variables are log(1+Total # of Digital Transactions, log(1+Total # of Digital Financial Transactions), and log(1+Total S$ Amount of Digital Transactions). Controls include monthly beginning account balance in thousands (Beginning Balance), Monthly Salary in thousands, year-month fixed effects, and customer fixed effects. Coefficient estimates are reported with t-statistics in parentheses based on standard errors clustered by the customer's favorite ATM, with ***, **, and * respectively denoting statistical significance at the 1%, 5%, and 10% levels. The Cragg-Donald Wald F-statistic for the IV is 70.041 in Panel A and 92.852 in Panel B.

Panel A: Shopping Mall-Location ATM Closures

	(1)	(2)	(3)
	log(1+# of Digital Txns)		log(1+S$ of
Variables	Total	Financial	Digital Txns)
$\widehat{\text{Distance to}}$ ATM	0.232***	0.119***	0.357**
	(3.06)	(2.61)	(2.51)
Beginning Balance	0.0001***	0.0002***	0.001***
	(4.65)	(7.55)	(9.83)
Monthly Salary	0.004***	0.003***	0.012***
	(8.58)	(8.92)	(10.06)
Observations	5,085,213	5,085,213	5,085,213
R-squared	0.707	0.652	0.700
Year-Month FE	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes

Panel B: Business-Location ATM Closures

$\widehat{\text{Distance to}}$ ATM	0.160***	0.092***	0.316***
	(3.94)	(4.19)	(3.89)
Beginning Balance	0.0002***	0.0002***	0.001***
	(6.71)	(9.21)	(10.84)
Monthly Salary	0.004***	0.003***	0.013***
	(10.28)	(10.43)	(11.20)
Observations	5,872,981	5,872,981	5,872,981
R-squared	0.780	0.710	0.718
Year-Month FE	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes

Table A3: Main Results Re-Estimated on Salary Subsamples

The customer-month observations in our sample are separated into two based on the customer's observed salary. Observations with no salary credit are excluded. Panel A (Panel B) reports estimations from the first group, the low (high) salary customers. Second stage regression estimates use *Distance to ATM* as the main independent variable (a transaction-weighted usage distance to ATMs from the provided customer address, instrumented by the two ATM closure shocks). The dependent variables are log(1+Total # of Digital Transactions, log(1+Total # of Digital Financial Transactions), and log(1+Total S$ Amount of Digital Transactions). Controls include monthly beginning account balance in thousands (Beginning Balance), Monthly Salary in thousands, year-month fixed effects, and customer fixed effects. Coefficient estimates are reported with t-statistics in parentheses based on standard errors clustered by the customer's favorite ATM, with ***, **, and * respectively denoting statistical significance at the 1%, 5%, and 10% levels. The Cragg-Donald Wald F-statistic for the IV is 46.916 in Panel A and 33.843 in Panel B.

Panel A: Subsample of Low Salary Customers

	(1)	(2)	(3)
	log(1+# of Digital Txns)		log(1+S$ of
Variables	Total	Financial	Digital Txns)
$\widehat{\text{Distance to}}$ ATM	0.234***	0.089**	0.312**
	(2.90)	(2.49)	(2.36)
Beginning Balance	0.0002**	0.0003***	0.002***
	(1.99)	(2.70)	(2.65)
Monthly Salary	0.037***	0.028***	0.123***
	(8.73)	(14.79)	(17.23)
Observations	1,608,501	1,608,501	1,608,501
R-squared	0.733	0.701	0.695
Year-Month FE	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes

Panel B: Subsample of High Salary Customers

$\widehat{\text{Distance to}}$ ATM	0.236***	0.112***	0.360***
	(3.36)	(3.09)	(2.66)
Beginning Balance	0.0001***	0.0002***	0.001***
	(5.13)	(6.71)	(7.56)
Monthly Salary	0.002***	0.002***	0.008***
	(8.77)	(9.17)	(10.21)
Observations	1,635,997	1,635,997	1,635,997
R-squared	0.721	0.721	0.727
Year-Month FE	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes

Table A4: Main Results Re-estimated using a Stacked Difference-In-Difference Approach in Reduced-Form

We construct a stacked difference-in-difference sample following Gormley and Matsa (2011). For each of the 36 months in our three-year sample, we construct a cohort of treated and untreated customers using customer-month observations (when available) for the six months before and the 12 months after the closure event. Treated customers are those who have experienced either a favorite ATM or a nearest ATM closure that month. Untreated customers for the cohort are those who did not experience any closures in the sample. *Post Closure* is defined as a dummy that equals one from event-months 0 to 12 for a customer in the cohort who experienced an ATM closure, and zero otherwise. We then stack the cohorts from the different closure months and estimate the impact of closures on our digital banking outcome variables on the resulting stacked panel. We include customer fixed effects and year-month fixed effects by cohort. We then report reduced-form estimates from a regression of digital banking activity on the *Post Closure* dummy. Coefficient estimates are reported with t-statistics in parentheses based on standard errors clustered by the customer's favorite ATM, with ***, **, and * respectively denoting statistical significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)
	log(1+# of Digital Txns)		log(1+S$ of
Variables	Total	Financial	Digital Txns)
Post Closure	0.016***	0.009***	0.027***
	(4.67)	(4.84)	(3.56)
Beginning Balance	0.0003***	0.0002***	0.002***
	(8.06)	(7.79)	(7.99)
Monthly Salary	0.003***	0.002***	0.010***
	(9.19)	(9.06)	(9.83)
Observations	73,397,470	73,397,470	73,397,470
R-squared	0.888	0.844	0.824
Year-Month FE by Cohort	Yes	Yes	Yes
Customer FE by Cohort	Yes	Yes	Yes

Table A5: The Effect of ATM Closures on the Clustered Distance to ATM

We report panel regression estimates of the effect of an ATM Closure Shock on a customer's clustered usage distance to an ATM. The dependent variable in models (1)–(3) is the *Clustered Distance to ATM*, a transaction-weighted usage distance to ATMs from the customer's location anchors, defined as the customer's postal address, and up to three other anchors obtained by clustering their ATM usage places and choosing the top three (based on frequency) cluster centers. The distance to an ATM is computed then as the minimum distance between the ATM and any of these anchors. In model (1), we use the *Post Closure (Favorite ATM)* as the main independent variable. *Post Closure (Favorite ATM)* equals to 1 from the ATM closure event when the closed ATM is the one that is the customer's favorite ATM based on the number of times used in the prior three months. In model (2), we use the *Post Closure (Nearest ATM)* as the main independent variable. *Post Closure (Nearest ATM)* equals to 1 from the ATM closure event when the closed ATM is the one that is closest to the customer's postal address. In model (3), we use both *Post Closure (Favorite ATM)* and *Post Closure (Nearest ATM)* as the main independent variables. Controls include the monthly beginning account balance in thousands (Beginning Balance), Monthly Salary in thousands, year-month fixed effects, and customer fixed effects. Coefficient estimates are reported with t-statistics in parentheses based on standard errors clustered by the customer's favorite ATM, with ***, **, and * respectively denoting statistical significance at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)
Variables	Distance to ATM		
Post Closure (Favorite ATM)	0.085***		0.070***
	(6.27)		(5.20)
Post Closure (Nearest ATM)		0.061***	0.051***
		(8.06)	(7.06)
Beginning Balance	-0.00001	-0.00001	-0.00001
	(-0.38)	(-0.40)	(-0.39)
Monthly Salary	0.0003**	0.0003*	0.0003*
	(1.96)	(1.96)	(1.96)
Observations	5,993,546	5,993,546	5,993,546
R-squared	0.524	0.524	0.524
Year-Month FE	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes

Table A6: Main Results Re-estimated Using a Clustered Distance Measure

We report Instrumental Variable (IV) regression estimates of the effect of ATM usage distance on customers' digital banking activity using ATM closure shocks as instrumental variables. The main independent variable is *Distance to ATM (Clustered)*, instrumented by the ATM Closure Shocks, is a transaction-weighted usage distance to ATMs from the customer's location anchors, defined as the customer's postal address, and up to three other anchors obtained by clustering their ATM usage places and choosing the top three (based on frequency) cluster centers. The distance to an ATM is computed then as the minimum distance between the ATM and any of these anchors. We use *Post Closure (Favorite ATM)* and *Post Closure (Nearest ATM)* as the IV. *Post Closure (Favorite ATM)* equals to 1 from the ATM closure event when the closed ATM is the one that is the customer's favorite ATM based on the number of times used in the prior three months. *Post Closure (Nearest ATM)* equals to 1 from the ATM closure event when the closed ATM is the one that is closest to the customer's postal address. The dependent variable for model (1) is the log of 1+ the Total Number of Digital Transactions, for model (2) is the log of 1+ the Total Number of Digital Financial Transactions, and for model (3) is the log of 1+ the Total S$ Amount of Digital Transactions. Controls include monthly beginning account balance in thousands (Beginning Balance), Monthly Salary in thousands, year-month fixed effects, and customer fixed effects. Coefficient estimates are reported with t-statistics in parentheses based on standard errors clustered by the customer's favorite ATM, with ***, **, and * respectively denoting statistical significance at the 1%, 5%, and 10% levels. The Cragg-Donald Wald F-statistic for the IV is 172.902.

	(1)	(2)	(3)
	log(1+# of Digital Txns)		log(1+S$ of
Variables	Total	Financial	Digital Txns)
Distance to $\widehat{\text{ATM}}$ (Clustered)	0.440***	0.230***	0.698***
	(6.74)	(6.48)	(5.67)
Beginning Balance	0.0002***	0.0002***	0.001***
	(8.50)	(10.65)	(11.72)
Monthly Salary	0.004***	0.003***	0.014***
	(11.10)	(11.15)	(11.81)
Observations	5,993,546	5,993,546	5,993,546
R-squared	0.726	0.665	0.707
Year-Month FE	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes

Table A7: Main Results Re-estimated with Movers Excluded

We report Instrumental Variable (IV) regression estimates of the effect of ATM usage distance on customers' digital banking activity using ATM closure shocks as instrumental variables. The main independent variable is *Distance to ATM*, a transaction-weighted usage distance to ATMs from the provided customer address, instrumented by the ATM Closure Shocks. We drop all customers who had an address change in the sample period of 2015–2017. We use *Post Closure (Favorite ATM)* and *Post Closure (Nearest ATM)* as the IV. *Post Closure (Favorite ATM)* equals to 1 from the ATM closure event when the closed ATM is the one that is the customer's favorite ATM based on the number of times used in the prior three months. *Post Closure (Nearest ATM)* equals to 1 from the ATM closure event when the closed ATM is the one that is closest to the customer's postal address. The dependent variable for model (1) is the log of 1+ the Total Number of Digital Transactions, for model (2) is the log of 1+ the Total Number of Digital Financial Transactions, and for model (3) is the log of 1+ the Total S$ Amount of Digital Transactions. Controls include monthly beginning account balance in thousands (Beginning Balance), Monthly Salary in thousands, year-month fixed effects, and customer fixed effects. Coefficient estimates are reported with t-statistics in parentheses based on standard errors clustered by the customer's favorite ATM, with ***, **, and * respectively denoting statistical significance at the 1%, 5%, and 10% levels. The Cragg-Donald Wald F-statistic for the IV is 163.627.

	(1)	(2)	(3)
	log(1+# of Digital Txns)		log(1+S$ of
Variables	Total	Financial	Digital Txns)
$\widehat{\text{Distance to}}$ ATM	0.194***	0.104***	0.322***
	(5.81)	(5.76)	(5.01)
Beginning Balance	0.0001***	0.0002***	0.001***
	(5.98)	(8.54)	(10.29)
Monthly Salary	0.004***	0.003***	0.013***
	(9.57)	(9.75)	(10.57)
Observations	5,508,322	5,508,322	5,508,322
R-squared	0.754	0.689	0.717
Year-Month FE	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes

Table A8: Main Results Re-estimated Only on Salary-crediting Customers

We report Instrumental Variable (IV) regression estimates of the effect of ATM usage distance on customers' digital banking activity using ATM closure shocks as instrumental variables. The main independent variable is *Distance to ATM*, a transaction-weighted usage distance to ATMs from the provided customer address, instrumented by the ATM Closure Shocks. We focus only on customers who had at least one salary credit in the sample period of 2015–2017. We use *Post Closure (Favorite ATM)* and *Post Closure (Nearest ATM)* as the IV. *Post Closure (Favorite ATM)* equals to 1 from the ATM closure event when the closed ATM is the one that is the customer's favorite ATM based on the number of times used in the prior three months. *Post Closure (Nearest ATM)* equals to 1 from the ATM closure event when the closed ATM is the one that is closest to the customer's postal address. The dependent variable for model (1) is the log of 1+ the Total Number of Digital Transactions, for model (2) is the log of 1+ the Total Number of Digital Financial Transactions, and for model (3) is the log of 1+ the Total S$ Amount of Digital Transactions. Controls include monthly beginning account balance in thousands (Beginning Balance), Monthly Salary in thousands, year-month fixed effects, and customer fixed effects. Coefficient estimates are reported with t-statistics in parentheses based on standard errors clustered by the customer's favorite ATM, with ***, **, and * respectively denoting statistical significance at the 1%, 5%, and 10% levels. The Cragg-Donald Wald F-statistic for the IV is 100.939.

	(1)	(2)	(3)
	log(1+# of Digital Txns)		log(1+S$ of
Variables	Total	Financial	Digital Txns)
$\widehat{\text{Distance to}}$ ATM	0.232***	0.117***	0.382***
	(4.91)	(4.69)	(4.24)
Beginning Balance	0.0002***	0.0002***	0.001***
	(6.27)	(8.74)	(9.62)
Monthly Salary	0.004***	0.003***	0.013***
	(9.90)	(10.34)	(11.23)
Observations	4,448,450	4,448,450	4,448,450
R-squared	0.695	0.651	0.683
Year-Month FE	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes

Table A9: First and Second Stage Results Re-estimated Without Control Variables of Beginning Balance and Monthly Salary

We report IV regression estimates of the effect of customers' total number of ATM transactions on digital banking activities using ATM closure shocks as an IV. The main independent variable is the log of 1+ the number of total ATM transactions, instrumented by *Post Closure (Favorite ATM)*. *Post Closure (Favorite ATM)* equals to 1 from the ATM closure event when the closed ATM is the one that is the customer's favorite ATM based on the number of times used in the prior three months. Panel A reports the first stage results where the dependent variable is *Distance to ATM* for models (1)–(3) and log of 1+ the total number of ATM transactions for models (4)–(6). Panel B reports the second stage results using the distance measure where the dependent variable for model (1) is the log of 1+ the Total Number of Digital Transactions, for model (2) is the log of 1+ the Total Number of Financial Digital Transactions, and for model (3) is the log of 1+ the Total S$ Amount of Digital Transactions. The usual control variables of Beginning Balance and Monthly Salary are excluded for both stages. But year-month fixed effects and customer fixed effects continue to be included. Reported coefficient estimates have *t*-statistics in parentheses based on standard errors clustered by the customer's favorite ATM, with ***, **, and * respectively denoting statistical significance at the 1%, 5%, and 10% levels. The Cragg-Donald Wald *F*-statistic for the IVs is 569.810.

Panel A: First-Stage Regressions

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Distance to ATM			log(1+# of ATM Total Txns)		
Post Closure	0.108***		0.074*	-0.059***		-0.058***
(Favorite ATM)	(2.65)		(1.82)	(-14.45)		(-13.99)
Post Closure		0.128***	0.117***		-0.010***	-0.001
(Nearest ATM)		(7.35)	(7.02)		(-4.26)	(-0.58)
Observations	5,994,130	5,994,130	5,994,130	5,994,130	5,994,130	5,994,130
R-squared	0.573	0.573	0.573	0.654	0.654	0.654
Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Second-Stage Regressions

	(1)	(2)	(3)
	log(1+# of Digital Txns)		log(1+S$ of
Variables	Total	Financial	Digital Txns)
$\widehat{\text{Distance to}}$ ATM	0.233***	0.122***	0.384***
	(5.55)	(5.45)	(4.91)
Observations	5,994,130	5,994,130	5,994,130
R-squared	0.708	0.645	0.688
Year-Month FE	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes

Table A10: Main Results Re-estimated by Separately Examining Favorite ATM Closures and Nearest ATM Closures

Panel A reports second stage regression estimates using *Post Closure (Favorite ATM)* as the closure shock, and Panel B reports second stage regression estimates using *Post Closure (Nearest ATM)* as the closure shock. The main independent variable is *Distance to ATM*, a transaction-weighted usage distance to ATM from the provided customer address, instrumented by the two ATM closure shocks. The dependent variables are log(1+Total # of Digital Transactions, log(1+Total # of Digital Financial Transactions), and log(1+Total S$ Amount of Digital Transactions). Controls in both panels include monthly beginning account balance in thousands (Beginning Balance), Monthly Salary in thousands, year-month fixed effects, and customer fixed effects. Coefficient estimates are reported with t-statistics in parentheses based on standard errors clustered by the customer's favorite ATM, with ***, **, and * respectively denoting statistical significance at the 1%, 5%, and 10% levels. The Cragg-Donald Wald F-statistic for the IV in Panel A is 80.740 and in Panel B is 222.896.

Panel A: Using only *Post Closure (Favorite ATM)* as the Closure Shock

	log(1+# Digital Txns)		log(1+S$ of
Variables	Total	Financial	Digital Txns)
$\widehat{\text{Distance to}}$ ATM	0.378***	0.197***	0.547**
	(2.69)	(2.61)	(2.46)
Beginning Balance	0.0001***	0.0002***	0.001***
	(2.95)	(6.07)	(9.77)
Monthly Salary	0.003***	0.003***	0.012***
	(6.39)	(7.70)	(9.80)
Observations	5,994,130	5,994,130	5,994,130
R-squared	0.484	0.400	0.591
Year-Month FE	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes

Panel B: Using only *Post Closure (Nearest ATM)* as the Closure Shock

$\widehat{\text{Distance to}}$ ATM	0.192***	0.101***	0.336***
	(4.74)	(4.78)	(4.29)
Beginning Balance	0.0002***	0.0002***	0.001***
	(6.40)	(9.22)	(10.94)
Monthly Salary	0.004***	0.003***	0.013***
	(10.33)	(10.56)	(11.37)
Observations	5,994,130	5,994,130	5,994,130
R-squared	0.751	0.693	0.710
Year-Month FE	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes

Table A11: Temporary Closures Separated by Length of Closure

Panel A reports the first stage regressions of Distance to ATM on very short temporary ATM closures versus other temporary closures. We separate the 34 temporary closures into two groups based on the median number of days closed (65). When one type of temporary closures is examined, all customers affected by the other type of temporary closures are excluded from the sample. Panel B reports second stage regressions of the effect of these ATM closures on digital banking activity using *Distance to ATM* as the main independent variable (a transaction-weighted usage distance to ATMs from the provided customer address, instrumented by the two ATM closure shocks). The dependent variables are log(1+Total # of Digital Transactions, log(1+Total # of Digital Financial Transactions), and log(1+Total S$ Amount of Digital Transactions). Controls include monthly beginning account balance in thousands (Beginning Balance), Monthly Salary in thousands, year-month fixed effects, and customer fixed effects. Coefficient estimates are reported with t-statistics in parentheses based on standard errors clustered by the customer's favorite ATM, with ***, **, and * respectively denoting statistical significance at the 1%, 5%, and 10% levels. The Cragg-Donald Wald F-statistic for the IV for very short temporary closures is 7.392 (model 3) and for other temporary closures is 61.377 (model 6).

Panel A: First-Stage Regressions

	Very Short Temporary Closures			Other Temporary Closures		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Distance to ATM			Distance to ATM		
Post Closure (Favorite ATM)	-0.016		-0.036	0.295***		0.295***
	(-0.33)		(-0.76)	(2.68)		(2.73)
Post Closure (Nearest ATM)		0.066**	0.071**		0.038	-0.003
		(2.07)	(2.18)		(0.70)	(-0.06)
Beginning Balance	0.0002***	0.0002***	0.0002***	0.0002***	0.0002***	0.0002***
	(3.66)	(3.66)	(3.65)	(4.14)	(4.14)	(4.14)
Monthly Salary	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***
	(6.80)	(6.80)	(6.80)	(7.40)	(7.41)	(7.40)
Observations	5,195,759	5,195,759	5,195,759	5,760,090	5,760,090	5,760,090
R-squared	0.568	0.568	0.568	0.572	0.572	0.572
Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes	Yes	Yes	Yes

Table A11 (Cont'd)

Panel B: Second-Stage Regressions

	Very Short Temporary Closures			Other Temporary Closures		
	(1)	(2)	(3)	(4)	(5)	(6)
	log(1+# Digital Txns)		log(1+S$ of	log(1+# Digital Txns)		log(1+S$ of
Variables	Total	Financial	Digital Txns)	Total	Financial	Digital Txns)
$\widehat{\text{Distance to}}$ ATM	-0.133	-0.038	-0.213	0.223***	0.120**	0.409**
	(-0.89)	(-0.51)	(-0.71)	(2.58)	(2.30)	(2.19)
Beginning Balance	0.0002***	0.0002***	0.001***	0.0001***	0.0002***	0.001***
	(5.73)	(8.14)	(9.92)	(4.78)	(7.57)	(10.04)
Monthly Salary	0.005***	0.003***	0.014***	0.004***	0.003***	0.013***
	(7.57)	(8.25)	(9.01)	(8.76)	(9.16)	(10.25)
Observations	5,195,759	5,195,759	5,195,759	5,760,090	5,760,090	5,760,090
R-squared	0.797	0.778	0.750	0.719	0.648	0.675
Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes	Yes	Yes	Ties

Table A12: Alternative Outcome Variable: Banking Fees Paid by the Customer

The dependent variable is *All Fees over Balance* in this second stage regression. Fees are the sum of all transaction amounts that have a reference associated with anything related to a service charge or a transaction fee, and we scale the sum of these amounts by the account balance at the beginning of the month. Various levels of winsorization to mitigate the impact of outliers are applied as indicated. *Distance to ATM* is the main independent variable (a transaction-weighted usage distance to ATMs from the provided customer address, instrumented by the two ATM closure shocks). Salary in thousands is used as a control variable and year-month fixed effects, and customer fixed effects are included. Beginning balance the usual control is omitted since balance is already used as an input in the dependent variable. Coefficient estimates are reported with t-statistics in parentheses based on standard errors clustered by the customer's favorite ATM, with ***, **, and * respectively denoting statistical significance at the 1%, 5%, and 10% levels. The Cragg-Donald Wald F-statistic for the IV is 123.396.

	Dependent Variable: All Fees over Balance			
	(1)	(2)	(3)	(4)
Winsorization	0%	1%	2%	5%
$\widehat{\text{Distance to}}$ ATM	-0.004*	-0.003*	-0.001	-0.0003
	(-1.80)	(-1.75)	(-1.25)	(-1.30)
Monthly Salary	-0.0001***	-0.0001***	-0.00004***	-0.00001***
	(-7.01)	(-7.11)	(-7.92)	(-8.82)
Observations	5,943,028	5,943,028	5,943,028	5,943,028
R-squared	0.292	0.300	0.372	0.487
Year-Month FE	Yes	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes	Yes

Table A13: Main Results Re-restimated after Dropping 2017

We report Instrumental Variable (IV) regression estimates of the effect of ATM usage distance on customers' digital banking activity using ATM closure shocks as instrumental variables. The main independent variable is *Distance to ATM*, a transaction-weighted usage distance to ATMs from the provided customer address, instrumented by the ATM Closure Shocks. We drop all 2017 observations so that the sample only includes 2015–2016. We use *Post Closure (Favorite ATM)* and *Post Closure (Nearest ATM)* as the IV. *Post Closure (Favorite ATM)* equals to 1 from the ATM closure event when the closed ATM is the one that is the customer's favorite ATM based on the number of times used in the prior three months. *Post Closure (Nearest ATM)* equals to 1 from the ATM closure event when the closed ATM is the one that is closest to the customer's postal address. The dependent variable for model (1) is the log of 1+ the Total Number of Digital Transactions, for model (2) is the log of 1+ the Total Number of Digital Financial Transactions, and for model (3) is the log of 1+ the Total S$ Amount of Digital Transactions. Controls include monthly beginning account balance in thousands (Beginning Balance), Monthly Salary in thousands, year-month fixed effects, and customer fixed effects. Coefficient estimates are reported with t-statistics in parentheses based on standard errors clustered by the customer's favorite ATM, with ***, **, and * respectively denoting statistical significance at the 1%, 5%, and 10% levels. The Cragg-Donald Wald F-statistic for the IV is 160.394.

	(1)	(2)	(3)
	log(1+# of Digital Txns)		log(1+S$ of
Variables	Total	Financial	Digital Txns)
$\widehat{\text{Distance to}}$ ATM	0.084***	0.048***	0.166***
	(3.28)	(3.53)	(3.40)
Beginning Balance	0.0003***	0.0003***	0.002***
	(7.07)	(7.80)	(8.09)
Monthly Salary	0.004***	0.002***	0.011***
	(10.18)	(10.25)	(11.07)
Observations	4,094,435	4,094,435	4,094,435
R-squared	0.854	0.802	0.790
Year-Month FE	Yes	Yes	Yes
Customer FE	Yes	Yes	Yes