EXAMINING CUSTOMER JOURNEYS AT FINANCIAL INSTITUTIONS IN CAMBODIA

Using Big Data to Advance Women's Financial Inclusion

ABSTRACT

National financial inclusion surveys such as Finscope, Intermedia and Findex provide significant insights into people's access to finance, but the understanding of customers' long-term financial service use remains limited. This study uses readily available big data from four Financial Service Providers (FSP) in Cambodia—covering approximately 21 percent of the loans and savings market—to examine how long customers stay with their financial institutions and what types of products they take up during their journey. Conducting survival analysis and applying a gender lens, this study finds that although men and women have equal access to credit and saving services, the actual amounts of loans and savings mobilized are much lower for women than men. Nearly 70 percent of customers had low-value or passive savings accounts with deposit balances below US$5 and women were more likely to have passive accounts (75 percent) than men (59 percent). Savings mobilization remains a challenge in Cambodia, particularly outside Phnom Penh and for older people, as these depositors are more likely to have passive accounts. The majority of borrowers (78 percent) exit the FSPs within the first three years, implying there is a limited long-term borrowing relationship. While women stay longer in the borrowing relationship for individual loans, they often receive lower individual loan amounts than men. The study estimates that reducing passive savings accounts and borrower exit by 10 percent could add an additional $52-$155 million to the deposit portfolio (10 to 33 percent for 2015 portfolio levels) and $304 million to the loan portfolio (24 percent) of the four FSPs as well as reduce operating expenses by $54 million. The paper offers business and policy recommendations for improving customer retention through better product development and recommends incorporating savings mobilization for women and youth into the National Financial Inclusion Strategy.

ABOUT UNCDF

The United Nations Capital Development Fund (UNCDF) **makes public and private finance work for the poor in the world's 47 least developed countries.** With its capital mandate and instruments, UNCDF offers "last mile" finance models that unlock public and private resources, especially at the domestic level, to reduce poverty and support local economic development. UNCDF's financing models work through two channels: **financial inclusion** that expands the opportunities for individuals, households, and small businesses to participate in the local economy, providing them with the tools they need to climb out of poverty and manage their financial lives; and by showing how **localized investments** — through fiscal decentralization, innovative municipal finance, and structured project finance — can drive public and private funding that underpins local economic expansion and sustainable development. By strengthening how finance works for poor people at the household, small enterprise, and local infrastructure levels, UNCDF contributes to SDG 1 on eradicating poverty and SDG 17 on the means of implementation. By identifying those market segments where innovative financing models can have transformational impact in helping to reach the last mile and address exclusion and inequalities of access, UNCDF contributes to a number of different SDGs.

ABOUT SHIFT

UNCDF's Shaping Inclusive Finance Transformations (SHIFT) programme is a financial market facilitation, technical assistance and funding facility for the ASEAN region. SHIFT aims to encourage people with low incomes, especially women, to move from dependence on informal financing mechanisms and to use formal and higher-value services by catalysing innovative partnerships across financial, policy, data and training markets. This study was conducted in collaboration with the UN Pulse Lab Jakarta to demonstrate the potential of big data[1] to generate gendered insights into inclusion in financial markets, to train financial service providers in sex-disaggregated customer data analytics and product development, and to inform the Cambodian national financial inclusion strategy. The UNCDF SHIFT programme is jointly co-funded by UNCDF and the Australian Department of Foreign Affairs and Trade (DFAT).

ABOUT UN GLOBAL PULSE

Global Pulse is a flagship innovation initiative of the United Nations Secretary-General on big data. Its vision is a future in which big data is harnessed safely and responsibly as a public good. Its mission is to accelerate the discovery, development and scaled adoption of big data innovation for sustainable development and humanitarian action. The initiative was established based on a recognition that digital data offer the opportunity to gain a better understanding of changes in human well-being, and to get real-time feedback on how well policy responses are working. To this end, Global Pulse is working to promote awareness of the opportunities big data presents for sustainable development and humanitarian action, to forge public-private data sharing partnerships, generate high-impact analytical tools and approaches through its network of Pulse Labs, and drive broad adoption of useful innovations across the UN System.

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1   Big data refers to data sources that require new tools or methods to capture, curate, and process data in an efficient way. Big data can be characterized by the large volume of data, the wide variety of types of data, and the routine processes by which it is collected. In the financial service industry this includes, in particular, transaction data and historical savings and loan balances. (See https://www.unglobalpulse.org/sites/default/files/Gender-equality-and-big-data-en-2018.pdf)

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ABBREVIATIONS AND ACRONYMS

AML	Anti Money Laundering
ASEAN	Association Of Southeast Asian Nations
FSP	Financial Service Provider
GDP	Gross Domestic Product
ID	Identification Document
ILO	International Labour Organization
KM	Kaplan-Meier
KHR	Cambodian Riel
KYC	Know Your Customer
LDC	Least Developed Countries
MAP	Making Access Possible
MIS	Management Information System
MDI	Micro-Deposit Institution
NBFI	Non-Bank Financial Institution
SHIFT	Shaping Inclusive Finance Transformations
SDG	Sustainable Development Goal
SME	Small And Medium-Sized Enterprises
UNCDF	United Nations Capital Development Fund

FOREWORD

The 2030 Agenda for Sustainable Development, the Addis Ababa Action Agenda, and the Denarau Action Plan emphasise the importance of financial inclusion for poverty reduction, inclusive growth, and women's economic empowerment. In order to maximize the impact that savings, loans, payments, and insurance products have on people's lives, financial services need to be tailored to the needs of customers - including youth, women and people in rural areas – so that such services are in practice used by them to improve their lives and livelihoods. This, however, is easier said than done. This study finds that in Cambodia, 7 out of 10 savings accounts remain passive and do not mobilise additional formal financial resources that can in turn be re-allocated – as through loans to small businesses - to promote economic and inclusive growth.

In response to this challenge, UNCDF, in collaboration with the UN Pulse Lab Jakarta, undertook the present study to encourage a shift in focus from examining access to finance to understanding actual usage of financial products and what actions might need to be taken to make improvements in that regard. More precisely, the study was conducted to demonstrate the potential of a big data approach both to generate granular sex-disaggregated information on the use of financial services, and to use those data to advocate new ways of working.

What is so exciting about this study is that it uses the readily available transaction data from four leading financial institutions – covering around half of the formal microfinance market in Cambodia – to investigate the shift from access to usage of financial services. In doing so, it tracks the customer's journey, looking at actual financial service usage patterns by sex, age and other demographic indicators, from the point people enter the financial institutions to the point they exit.

During the preparation of the study, UNCDF and the UN Pulse Lab Jakarta offered data analytic training support to four leading Cambodian financial service providers and two regulators -the Ministry of Economics and Finance and the National Bank of Cambodia - to promote gender-sensitive policymaking and product development. The report also contributes to the sex- and youth-disaggregated monitoring and evaluation of Cambodia's National Financial Inclusion Strategy.

At UNCDF, we have taken the study's insights to heart. They are already informing our support for the piloting of digital-linked savings products in Cambodia under the SHIFT Challenge Fund in order to promote women's financial inclusion. I hope you likewise find its findings interesting, and that it is ultimately able to inspire greater usage of financial service products that help Cambodians build a better future.

Judith Karl
Executive Secretary, UNCDF

AUTHORSHIP

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EXECUTIVE SUMMARY

Over the course of the last decade, Cambodia has experienced rapid poverty reduction and economic growth. This has been accompanied by an accelerated rate of financial inclusion. Nearly 59 percent of adults in Cambodia have access to formal finance (FinScope, 2015) which is dominated by the domestic payment markets (to which 37 percent have access) and credit markets (to which 28 percent have access). Like most developing ASEAN nations, young, rural and low-income Cambodians have significantly less access to formal finance than the overall adult population. Interestingly, Cambodian women have slightly greater access to formal financial services (2 percent) than men because they receive more remittances, but they are underserved in terms of credit and savings.

Access to formal financial services does not necessarily imply efficient and active use of such services for personal consumption, investment, or business activities. As many as 22 percent of Cambodian adults have inactive saving accounts, which have had no deposits or withdrawals in the past one year (Findex, 2017), and the borrower exit rates from Cambodian Microfinance deposit institutions (MDIs) vary between 28 percent and 39 percent per annum (MIX Market, 2015). When financial services are appropriately designed and used effectively by the under-served population, they can contribute more strongly to sustainable development goals such as poverty reduction (SDG1), women's economic empowerment (SDG5), inclusive economic growth and decent work (SDG8) (see e.g. ILO, 2015; Buvinic and O Donnel, 2016; Banerjee, Karlan et al., 2015). This paper investigates for how long customers use a variety of financial products and services, how efficiently they use them, and whether those usage patterns differ by gender, age, and location (rural/urban).

This paper examines customers' loan and savings mobilization patterns by using readily available management information system (MIS) data from four leading Cambodian FSPs: AMK; AMRET; Sathapana Bank; and WB Finance (formerly Vision Fund). The consolidated dataset contains around 5.4 million loan and savings records for 2.3 million customers, which represents almost a quarter of Cambodia's total adult population in 2015. The study covers around 60 percent of the depositors and 53 percent of the borrowers from the Cambodian microfinance sector, and around 22 percent of depositors and 38 percent of borrowers from the Cambodian banking sector. The dataset contains information on customers' gender, age, province, and their savings and loans products, allowing us to study long-term financial service usage for different groups of customers during the period 2010-2015. The big data study applies descriptive and survival analysis to measure the customer journey, looking at actual financial service usage patterns by sex, age and other demographic indicators, from the point people enter the financial institutions to the point of their exit. Insights were further triangulated with Cambodia's National Financial Inclusion Survey (FinScope 2015) (n=3150) as well as feedback from over 80 FSP experts to identify why certain underlying patterns occurred.

The study finds significant gender and youth gaps in average loans and savings mobilization in Cambodia.[1] While Cambodian men and women have almost equal access to formal financial services, the loan and savings mobilization is higher among men (the gender gap in loan amounts is $825 and in savings is $658). This gender gap may be explained by existing gender inequalities in wages and incomes, access to assets and employment activities in Cambodia (see e.g. ADB, 2013) and the fact that women have a preference for informal savings schemes (FinScope, 2015) and

group loans. Cambodian youth (defined as those between 18-25 for the purposes of this study) have 20 percent lower access to formal finance than older adults, and they also save and borrow less (the youth gap in loans is $567 and in savings is $215). Despite stronger customer loyalty, youth and women received smaller individual loans due to lack of credit history and collateral and a perceived lack of business skills and experience.

Nearly 70 percent of customers had low-value or "passive savings accounts"[2] with deposit balances below $5. Results of survival analysis show that the level of a customer's savings is most likely to fall below $5 within the first year of the account opening. Descriptive analysis showed that the percentage of passive accounts was higher among depositors with credit-linked savings (72 percent) than with voluntary accounts (45 percent), indicating that linking credit and savings accounts did not advance savings mobilization. Women (75 percent) and older adults (72 percent) have a significantly higher proportion of passive accounts than men (59 percent) and youth (47 per cent) respectively.

Among the key reasons for there being a large proportion of passive savings accounts in Cambodia are: customers' limited awareness of savings account ownership opportunities; low financial literacy; limited access points in rural areas; and the attractiveness and convenience of informal savings. Nearly 60 percent of adults are unaware of formal saving methods, 54 percent cannot reach a bank within 30 minutes, and 33 percent of the adult population saves informally, while only 10 percent use formal savings (FinScope, 2015). Cambodia has a strong informal savings culture, especially among women, with people using 'tong tings' (a type of rotating savings group) and savings in cash or in livestock. Amongst informal savers, nearly 50

percent save to engage in business or farming activities, indicating that these activities deliver higher returns than savings in the bank. On the supply side, credit-linked savings accounts are often opened merely to function as repayment vehicles for loans. In addition, staff and customer incentive systems are geared towards improving savings access and not savings usage. Savings products are not linked to regular income streams, such as wages and pensions. In fact, 92 percent of people receive their income in cash, rather than directly into their bank account and it remains challenging for depositors to make payments or transfer remittance from their savings accounts, especially in rural areas.

On the credit side, survival analysis[3] finds that customers have a limited borrowing relationship with FSPs; 39 percent of the borrowers exited the loan programme after the first year and 78 percent of borrowers exited within three years. Women, youth and rural customers are more loyal borrowers, yet they receive lower individual loans than men and older adults respectively. We also find strong differences in exit rates among FSPs, varying as much as 24 percent between the top performing and the weakest performing FSP, which indicate that borrower exit is at least partly under the control of the FSP and not just an issue of competition and market saturation (Mimosa, 2016). In some cases, borrowers may exit because they have become financially self-sufficient and do not require further loans. However, high exit rates also suggest that loan products are not tailored to the needs of borrowers.[4]

There is a strong business case for FSPs to lengthen customer journeys by improving savings and loan mobilization, especially among women and youth. We find that depositors with longer journeys at FSPs mobilized higher savings into their accounts;

depositors staying for five years with FSPs saved nearly 4.5 times more than the level of their average opening balances ($174 compared with $820 in savings account balances) and 1.8 times more than short-term depositors staying for a year ($453 compared with $820). Long-term borrowers who stayed with the FSP for three years also took up slightly larger loans ($613) compared with those who stay with the FSP for one year ($521). We estimate that reducing the number of passive savings accounts by between 10 percent and 30 percent[5], would mobilize an additional $52 to $172 million of savings into the four FSPs. Likewise, reducing the borrower exit rate by 10 percent (from 39 percent to 29 percent) is estimated to contribute an additional $304 million to the loan portfolio of the four FSPs, equivalent to an increase of 24 percent in the portfolio. Improving borrower retention will help FSPs to better manage operational expenses, which becomes ever more important in the context of the current interest rate cap (Roviay, 2017). Assuming acquiring a new customer is at least five times costlier than retaining an existing one, it is estimated that a 10 percent reduction in borrower exits could further reduce the operational expenses of the four FSPs by around $54 million.[6]

Key barriers to savings mobilization and factors contributing to the prevalence of passive savings accounts include the attractiveness of informal savings over formal savings, limited delivery channels for women and in rural areas, limited linkage between savings accounts and payments and income streams, and low financial literacy. Key barriers to borrower retention include weak customer assessments and limited customer loyalty programmes. Under the influence of increased customer data collection, big data analytics and digital finance movements, the potential to use consumer data for product development and policymaking has increased. Below we identify a selective set of financial

technologies (fintech) and digital finance measures for FSPs and policymakers that can ease the transition from access to use of financial services.

RECOMMENDATIONS TO IMPROVE CUSTOMER JOURNEYS FOR FSPS

Promote mobile wallets to allow more convenient formal savings:

Mobile wallets allow FSPs to move away from product-specific approaches towards a more unified customer-oriented approach by offering multiple products through one mobile phone touch point. They can offer convenient alternatives to informal savings, as deposits can be made in relatively low and frequent amounts, mirroring the convenience of informal savings and mitigating some of the major barriers to using established banks for low-income customers. Examples of mobile wallets in Cambodia that are increasingly moving from providing payments to include other services are ABA Mobile, TrueMoney, PiPay and Wing.

Tailor delivery of savings services to female and rural customers to improve savings mobilization:

In Cambodia, one specific challenge is that deposits often have to be made at the MDI branches, and users of mobile wallets and savings accounts still require agent networks and doorstep banking to penetrate rural areas. An example of tailoring delivery networks better to women customers is the LienVietPostBank in Viet Nam, which partnered with the national women's union to offer a distribution network with accompanying financial literacy workshops.

Develop delivery channels to provide better access to savings in rural areas:

 In Cambodia one specific challenge is that deposits often have to be made at MDI branches. Yet nearly 50 percent of adults in

Cambodia take more 30 minutes to reach a bank or MDI (FinScope, 2015). As many users of mobile wallets and savings accounts still require cash, agent networks and doorstep banking are necessary in rural areas and provide an opportunity to help clients use all suitable available products. For example, Equity Bank in Kenya, which uses a rural agent network, mobilizes 20 percent of its deposits digitally. Another example includes the Pafupi savings accounts of NBS Bank in Malawi which are opened by mobile sales agents in less than ten minutes with local agents visiting women customers in rural communities. The account holders are also given an ATM card to use for withdrawals at agent locations and at any NBS Bank ATM (UNCDF MicroLead, 2018).

Link savings accounts to regular income streams such as wages and pensions and payment services to turn passive accounts active:

An example is the AMRET family savings product, a digital e-wallet that aims to link the income streams of garment factory workers to their family savings and payment accounts. Likewise, mobile network operators (MNOs) and fintech providers can partner with banks and microfinance institutions (MFIs) to ensure payments and savings can be made by customers. An example is Paytm wallet in India, which was originally a payments application but now allows users to link their mobile wallet with their savings accounts and debit and credit cards from other FSPs to link savings and payments.

Enhance digital financial literacy and savings product awareness among customers:

Fintech firms such as Juntos increase savings mobilization by sending personalized messages on mobile phones and social media to depositors with dormant accounts, either reminding them or making them aware of their dormant savings account.

Another cost-effective approach to increase product usage is through digital financial literacy applications. For example, Wave Money in Myanmar is designing a financial gaming application where people can learn about savings, interest payments and insurance. There are even digital education tools tailored to children, including mobile piggy banks such as Ernit and Bankaroo. Another option is to design commitment savings accounts, whereby savings are held by the bank until a pre-determined goal, set by the customer, has been met which have been effective in improving savings mobilization for women (Buvinic and O'Donnel, 2016).

Improve customer assessment and reward customer loyalty:

Design customer loyalty programmes and reduce interest rates for long-term customers that take follow-up loans and mobilize deposits. Retained customers are more cost-effective and take up larger loans and savings than new customers, yet the pricing models of banks do not always reflect this pattern. For example, although women and youth in Cambodia had longer customer journeys, they were offered similar pricing and received lower loan amounts than men. Customer data can be leveraged to develop alternative credit scoring models using mobile phone and transaction data not only to reduce collateral requirements, but also to improve on customer retention. Examples of fintech firms working on customer loyalty improvements include Retentionscience, Feedzai, and ZestFinance.

Given that borrower exit is partly under the control of FSPs, good customer assessment matters. In addition to using insights from management information reports and exit surveys, FSPs can also use low-cost software such as R-Studio and Tableau to generate customer insights to develop more appropriate products.

POLICY RECOMMENDATIONS FOR REGULATORS

Establish digital identity database:

Harmonizing the use of national ID cards in the MDI sector can greatly reduce the time and cost of delivering financial services in Cambodia, where 95 percent of adults are reported to have such a card (FinScope, 2015). As an example, Aadhar in India was established to target delivery of financial services and government-to-person payments such as subsidies, wages and pensions, combining these services with an "all-in-one" proof of national identity. Other countries such as Malaysia and Singapore also have multi-functional digital national identification cards for citizens (which serve the purpose of a driver's licence, an ID card, a health document and can serve as a digital wallet and a means of payment, amongst other functions), which has helped increase financial inclusion. A more standardized identification database can further support the protection of customers and help to increase the monitoring of over-indebtedness and cross lending for the FSPs and credit bureaux.

Explore regulatory technologies (RegTech):

Technology can also help to monitor the increased number of transactions and necessary KYC regulatory compliance, while strictly complying with applicable data protection laws and regulations (e.g. General Data Protection Regulation in the European Union). Examples include IdentityMind global, Onfido, Ancoa, and AQMetrics which conduct Know Your Customer (KYC) and Anti Money Laundering (AML) fraud prevention checks. Another interesting example in the field of customer rights and consent to use data includes Trunomi, which provides customer data rights management technology to private sector companies that enables businesses to request, receive and capture customer consent to use their personal data. All this enables financial service providers to comply with regulations by putting in place auditable workflows to record and prove the lawfulness of processing of customer data.

Facilitate partnerships between banks and non-bank institutions:

Mobilize small savings, especially among women and people in rural areas. Implement policies that allow mobile wallet providers to link their mobile money accounts with the savings accounts at Banks and MDIs. Allow interest bearing on savings wallets for the Cambodian FSPs to help to incentivize the promotion and usage of digital wallets. Allow MDIs to do interbank transfers with other FSPs to make savings products more convenient for account holders.

Examine the after-effects of the interest rate cap on financial inclusion:

To offset the risks of an interest rate cap, FSPs are likely to offer higher loan sizes, lengthen the loan period, and charge higher upfront fees. This may then widen the gender gap in loan mobilization because rural and female customers often need lower loan amounts. The repercussions of an interest rate cap are relevant in the context of a national financial inclusion strategy which focusses on the financial inclusion of women and un- and underserved (rural) populations.

Incorporate financial service usage and customer-value insights into monitoring indicators for the National Financial Inclusion Strategy:

In this regard, segmented customer data by sex and age can be used for design, implementation, and evaluation of policies aimed at improving financial inclusion and financial services usage in Cambodia.

KEY FACTS

- Despite having equal access to savings and credit services, on average women in Cambodia had $658 lower savings balances and $825 lower loan amounts than men.
- Youth hold lower savings balances ($382) than older adults ($597), but they tend to use their savings accounts more proactively.
- Nearly 70 percent of customers had low value or passive deposit accounts with balances below $5.
- Women (75 percent) and older adults (72 percent) have a significantly higher proportion of passive accounts than men (59 percent) and youth (47 percent) respectively.
- Customers who started with both savings and loan products have a significantly higher proportion of passive savings accounts (72 percent) in the first year compared with those customers starting their journey with only a savings product (45 percent).
- The majority of borrowers (78 percent) exit the FSPs within the first three years, which implies there is a limited long-term borrowing relationship. While women stay longer in the borrowing relationship for individual loans, they received lower individual loan amounts than men.
- Amongst individual loan customers, youth have 7 percent lower exit rates compared with older adults, implying that they are more loyal borrowers.
- There are strong differences in exit rates among FSPs, varying as much as 24 percent between the top performing and the weakest performing FSP.
- The study estimates that reducing passive savings accounts and borrower exit by 10 percent to 30 percent could add an additional $52-$172 million to deposit portfolios (an additional 10 percent to 33 percent on 2015 portfolio levels) and $304 million to loan portfolios (24 percent) of the four FSPs as well as reduce operating expenses by $54 Million.

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1   The differences in average loans and savings amounts between women and men and youth and older adults respectively.

2   To analyse the savings mobilization of customers, we define accounts with savings below US$5 as "passive accounts". This savings balance threshold of $5 is a reasonable proxy for savings account dormancy as over 80 percent of the dormant savings accounts had savings balances less than $5.

3   Originating from medical science, survival analysis has recently been widely applied in the field of economics, finance and engineering, amongst others. Examples of its application include measuring the length of survival-time (or death) of cancer patients after diagnosis or to measure the "period of unemployment" after providing a training to a group of unemployed individuals.

4   See Churchill and Halpern (2001); Copestake (2002); Pagura (2004); Imp-Act (2004), Microsave (2005).

5   This implies that we reduce the proportion of depositors with passive accounts from 70 percent to 40 percent (by 30 percent) over a period of time. The depositors with passive accounts may be saving informally such as at their households or with family or friends. On par with average savings of depositors at four FSPs, the depositors with passive accounts can also mobilize $579 to their formal savings accounts, which presently they save informally.

6   A reduction of $54 million in operational expenses is equivalent to a 11.6 percent reduction in total cumulative expenses of $465 million over the period 2010-2015.

01
INTRODUCTION

While significant research has been conducted on financial access through surveys such as Finscope, Findex and Intermedia, as well as through impact evaluations (Buvinic and O'Donnell, 2016), market-level insights on actual financial service usage are still limited. Addressing this data gap is important because financial service use ultimately determines the potential impact that savings, credit, payment, and insurance services can have on inclusive growth and women's empowerment. Under the influence of increased customer data gathering, big data analytics and digital finance movements, the potential to analyse consumer behaviour has significantly increased and can generate market-level insights for financial inclusion.

This working paper explores the loan and savings mobilization habits of customers using readily available management information system (MIS) data from four leading Financial Service Providers (FSPs). The scope of this study is to address sector-level data gaps on finance in Cambodia and gain long-term financial service usage insights. We apply survival analysis (for a comprehensive definition of survival analysis, see annex. 1) to measure the customer journey —looking at actual financial service use patterns by sex, age and other demographic indicators —from the point where people first engage with the financial institutions to the point of their exit. We then identify underlying factors that lead to costly customer exit and identify business and policy solutions to help lengthen and enhance the customer journey.

Section 2 analyses the Cambodian financial market context using demand-side FinScope Consumer Survey data. Section 3 briefly describes the supply-side data mining process and the methodology of survival analysis. Section 4 presents the overall outcomes and Section 5 offers suggestions to improve financial policies and practices for FSPs and regulators.
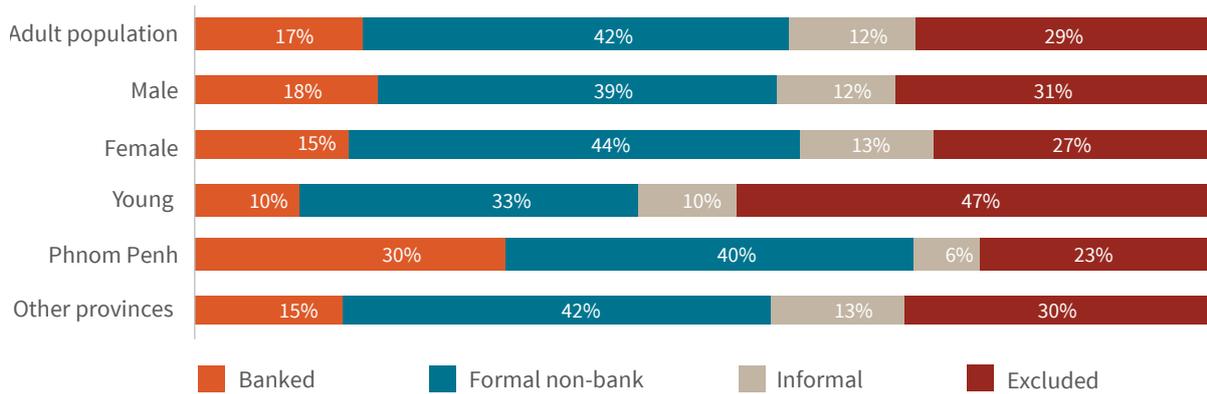
02

ACCESS TO FINANCE IN CAMBODIA

Cambodia has experienced unprecedented poverty reduction, with the share of people living below the national poverty line falling from 50.2 percent in 2003 to 13.5 percent in 2014 (WDI 2016). This reduction in poverty was accompanied by strong economic growth at 5.5 percent per annum as well as rapid financial sector development; domestic credit outstanding rose from 5.4 percent of GDP in 1994 to 53 percent of GDP in 2015 and gross domestic savings from 0 percent in 1994 to 18 percent in 2015. The latest national representative financial inclusion survey conducted in 2015 (FinScope) demonstrates that 59 percent of the adult population access formal financial services[1] from a bank or formal non-bank financial institution (NBFI), 12 percent access informal services and 29 percent remain financially excluded (see Figure 1). The predominant market in terms of financial access is the domestic payment market, offering services to around 37 percent of the adult population, followed by credit (28 percent), savings (10 percent), international remittances (10 percent) and insurance (4 percent). Approximately 37 percent of the adult population use two or more financial products. Like many other ASEAN countries, Cambodia has only a small access gap in terms of gender and youth, and people outside the capital city have less access to finance compared with the overall population (FinScope, 2015).

A large portion of the Cambodian population lacks access to credit (58 percent) and savings services (57 percent) (see Figures 2 and 3). Men and women have almost equal access to savings and credit, yet women more often access informal financial services. Many Cambodians (33 percent) prefer to save informally through unregulated institutions such as community-based cooperatives, 'tong tins', or with family/friends rather than through formal channels (10 percent). Access to informal savings channels is much higher for women (37 percent) than it is for men (28 percent), indicating women may find informal products more convenient, trustworthy and accessible. Young Cambodians are particularly excluded from formal credit and savings services. In terms of geography, there is strong access to savings in Phnom Penh, but lower access to credit compared with the overall country.

Between 2005 and 2016, the total number of depositors in the microfinance sector increased rapidly by 23 percent per annum from approximately 150,000 to 1,502,488 (NBC, 2016), with women accounting for 70 percent of depositors. The rapid increase in the number of microfinance institutions played a key role in expanding financial access to rural areas, low-income clients and women. In the credit market, high rates of repayment and fast growth were accompanied by significant borrower exit rates varying between 28 and 39 percent (MIX Market, 2015). This means that out of 100 borrowers who take a loan, on average, only 61 to 72 percent return for a follow up loan the following year. Similarly, the growth in number of depositors was accompanied by a significant increase in the number of inactive savings accounts with no deposits or withdrawals in the past year; Findex (2017) estimates one out of five accounts in Cambodia to be inactive (see Figure 4).

Figure 1: Percent of Adult Population with Access to at Least One Financial Product in 2015

	Banked	Formal non-bank	Informal	Excluded
Adult population	17%	42%	12%	29%
Male	18%	39%	12%	31%
Female	15%	44%	13%	27%
Young	10%	33%	10%	47%
Phnom Penh	30%	40%	6%	23%
Other provinces	15%	42%	13%	30%

Source: FinScope UNCDF-MAP Consumer Survey Cambodia 2015

Figure 2: Percent of Adult Population with Access to Credit in 2015

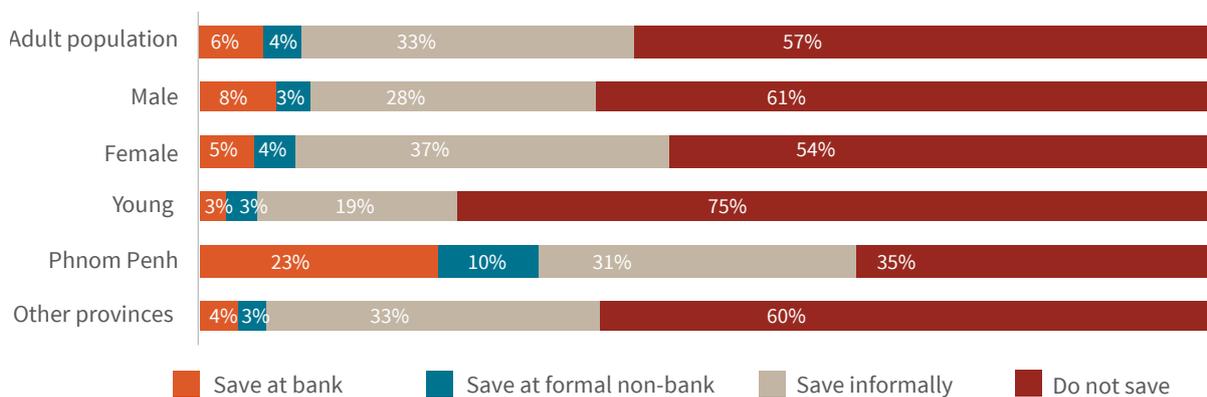|	Borrow from bank	Borrow for other formal	Borrow from informal	Do not borrow
Adult population	6%	22%	14%	58%
Male	6%	22%	12%	59%
Female	5%	22%	16%	56%
Young	5%	14%	10%	70%
Phnom Penh	8%	17%	9%	67%
Other provinces	5%	23%	15%	57%
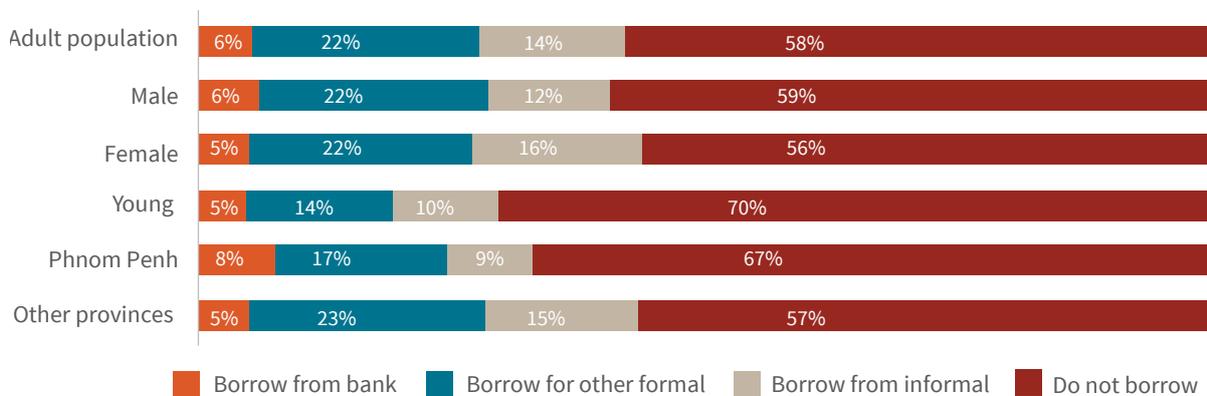
Source: FinScope UNCDF-MAP Consumer Survey Cambodia 2015

Figure 3: Percent of Adult Population with Access to Savings in 2015

	Save at bank	Save at formal non-bank	Save informally	Do not save
Adult population	6%	4%	33%	57%
Male	8%	3%	28%	61%
Female	5%	4%	37%	54%
Young	3%	3%	19%	75%
Phnom Penh	23%	10%	31%	35%
Other provinces	4%	3%	33%	60%

Source: FinScope UNCDF-MAP Consumer Survey Cambodia 2015

The apparent significant gap between access to and use of savings and credit services is worth investigating. FSPs can substantially benefit by reducing the number of inactive accounts and borrowers who exit and by increasing loan and savings mobilization. For example, the cost of screening a retained borrower is considered to be almost five times less than for new borrowers because the transaction costs decrease for follow-up loan cycles as records of repayment and other information are revealed (Churchill, 2002). Likewise, improved customer satisfaction can result in increased cross selling of other products, including savings, insurance and payment products and can improve revenue (Churchill and Halpern, 2001; Copestake, 2002; Pagura, 2004;

Figure 4: % Inactive Accounts in the ASEAN Region, 2017
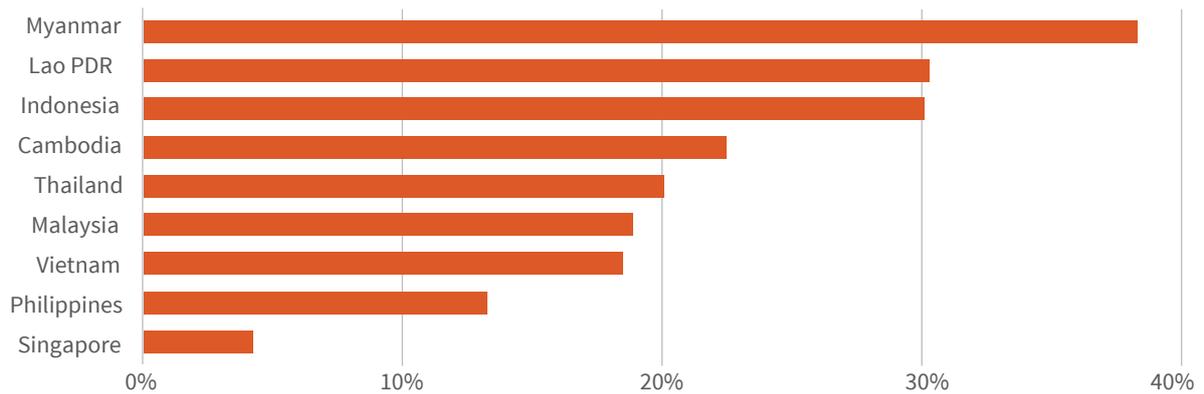
Microsave, 2005). Whilst it is understood that high borrower exit rates and passive and dormant savings accounts can indicate that products are not meeting the needs of clients, very few studies have clearly measured the costs attached to customer inactivity and exit (Imp-Act, 2004).

High passive savings accounts and borrower exit are not only costly for FSPs, they also limit financial service usage and with that the inclusive growth and women's empowerment impacts that can be generated through savings mobilization (Ashraf, Karlan, and Yin, 2010; Dupas and Robinson, 2013; Prina, 2013; Karlan, Ratan and Zinman, 2014; Kast and Pomeranz, 2014 l; Buvinic and O'Donnel, 2016), and to lesser extent credit (Banjeree, Karlan and Zinman, 2015; Buvinic and O'Donnell, 2016; Cho and Honorati, 2003). In order to unlock the benefits of financial inclusion for the sustainable social and economic empowerment of the underserved population, including women, formal financial services have to be efficiently and actively used by consumers over the long term. Thus a few open questions remain to be answered: how effective is the use of financial services at FSPs and for how long do customers typically use products and services? What products do customers take up during their product lifespan from the point where they enter the bank and start using financial services to their point of exit? Do people with different demographic and geographic characteristics (e.g. gender, age, rural/urban) have different patterns of financial service use?

In light of these questions, in recent years there has been an increased shift in attention away from product-specific approaches towards more customer-centric approaches. These overlapping approaches have been given different names, including "Customer Journey", the "life-cycle approach", "customer centricity," or "social performance management" (Gravesteijn et al., 2015; Imp-act 2004). While these approaches are not new, under the influence of increased customer data collection, big data analytics and digital finance movements, the potential to analyse customer behaviour has been significantly enhanced. At the wider market level, this allows us to generate new insights into financial service usage.

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1   Formal financial services are defined as any services offered by a bank or non-bank provider that is regulated by the National Bank of Cambodia or Ministry of Economics and Finance. Informal financial services are not regulated or supervised by the National Bank of Cambodia, they may consist of savings and credit associations, family members and relatives, Village and Savings Loan Associations (VSLAs), 'tong tings', and local moneylenders.

03
METHODOLOGY

This working paper analyses a unique set of customer big data obtained from four large Cambodian FSPs: AMK; AMRET; Sathapana Bank; and WB Finance (formerly Vision Fund) for the period 2010 to 2015 to capture a long-term overview of loan and savings services use. The readily available data from FSPs' Management Information Systems (MIS) was gathered as a part of an action research project implemented by the UNCDF SHIFT Programme. The project established data partnerships to support financial institutions in Cambodia with technical and analytical support in tracking and managing their financial and social objectives. In close collaboration with UN Pulse Lab Jakarta, the project experimented with big data analytics with the aim of adding value to analysis processes, product development, business operations, and financial inclusion mission tracking for FSPs, as well informing policy and regulation for the wider market.

The consolidated dataset contains around 5.4 million savings and loan balance records for 2.3 million customers, which represents almost a quarter of Cambodia's total adult population in 2015. Among the 2.3 million customers there are 958,464 depositors and 2,057,010 borrowers. The study covers around 60 percent of the total depositors and 53 percent of the total borrowers from the Cambodian microfinance sector, and 22 percent of the total depositors and 38 percent of the total borrowers from the Cambodian banking sector as of 2015. Product datasets on savings and loans were linked and mined into customer datasets that record total savings balances and loans outstanding as per December each year per customer for the period of 2010-2015.

There are two main types of savings accounts in Cambodia, namely "open savings accounts" which generally have a minimum opening balance and offer low interest on deposits (varying from 0.5 percent to 5 percent a year, depending on the savings balance) and term deposit accounts which mobilize larger amounts of savings for a fixed period and offer a higher interest rate on deposits. Since FSPs offer savings products in both US Dollars and Cambodian Riels (US$ and KHR), accounts with savings in KHR were converted to US$ using year-end KHR-US$ exchange rates. On the credit side, there are broadly two types of loans, namely group loans which are solidarity group lending schemes with joint liability and individual loans which are larger loans to individual borrowers. Unless otherwise specified, the savings balance in this study refers to the total deposits of customers in both savings accounts and term deposit accounts and the average loan amount includes both individual and group loans.

The data collected from the FSPs did not include any individually identifiable data, such as phone numbers, names, addresses, bank account numbers etc. UNCDF and UN Pulse signed strict data non-disclosure agreements with all four FSPs and complied with all applicable regulations. The unique client IDs in data sets from all four FSPs were coded to generate anonymized IDs for obtaining customer-level insights. All datasets were password encrypted and only members of UN Pulse and UNCDF working on the present study had access to the data.

Data was analysed in two iterative rounds. During the first round of analysis, the four different datasets were analysed separately for comparative

purposes, and the data was disaggregated by gender. The results were shared with the four FSPs to gather feedback into why certain patterns occurred, which then led to further testing and deepening of the analysis. The second round of analysis was made on the consolidated sample of all four FSPs using common indicators. Data is disaggregated by sex, age, financial institution, products (savings account and term deposits, individual and group loans), and geography (Phnom Penh and other provinces). The patterns emerging from the data were then triangulated with expert feedback as well as data from the FinScope Consumer Survey of Cambodia in 2015.

We applied survival analysis[1] to measure the customer journey, looking at the actual financial service use patterns by sex, age and other demographic indicators, from the point where people enter the financial institutions to the point of their exit. The survival analysis measures the lifetime and failure rates of borrowers and depositors at FSPs. The lifetime (or survival time) is the number of years for an "event of interest" to persist. For borrowers, we define this event as lasting until their complete exit from the FSPs and for depositors the event is defined as lasting until the total savings balance falls below $5. The lifetime is the difference between the start time, which is the "year of first loan" for borrowers and the "account opening year" for depositors, and exit time.[2]

The Kaplan-Meier is the primary statistical method used to estimate the survival rates as a function of time (See Annex 1). One (1) minus the survival rate is the cumulative failure rate. We apply the Kaplan-Meier method to compare failure rates among different groups of borrowers and depositors over time, segmented by gender, province, age, FSPs, and specific loan and savings products. The cumulative failure rates are estimated separately for each group of customers and the failure curves for different customer segments are plotted on the same graph for comparison. The data set used for estimating failure rates is smaller than the overall sample

because some of the observations are censored. The following observations were censored in the survival analysis; namely 1) depositors whose savings do not fall below $5 between 2010-15; 2) borrowers who did not exit the FSPs between 2010-2015; 3) the depositors who moved away from an FSP and closed their accounts; and 4) depositors and borrowers having only one year of data available. The survival analysis therefore covers only 326,405 depositors, with an average savings balance of $977, and 1,389,627 borrowers with an average loan size of $418.

For the purpose of this paper, we refer to "passive savings accounts" as those of customers with a total savings balance below $5 for all accounts combined. We apply this definition for three main reasons: first, we are interested in understanding savings account use among different groups of depositors over a period of five years; second, we have no data on savings transactions, but only on total savings account balances and lastly, crosschecks based on several monthly FSP reports showed that low-value passive savings accounts can serve as a reasonable proxy for measuring dormant savings accounts. Over 80 percent of the dormant savings accounts had savings balances of less than $5. We have also noticed that some of the savings products offered by FSPs have minimum account opening balance (up to $10) and minimum ongoing balance (up to $5) requirements. We therefore conducted an additional detailed sensitivity analysis on the savings failure rates by using a $10 threshold and found that 90 percent of the dormant savings accounts have a savings balance below $10.

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1   Originating from medical science, survival analysis has recently been widely applied in the field of economics, finance and engineering, amongst others. Survival analysis for example is used to measure the length of survival-time (or death) of cancer patients after diagnosis or to measure the "period of unemployment" after providing a training to a group of unemployed individuals.

2   For example, a customer starting savings mobilization in 2012 and whose savings went below $5 in 2014 would have a 2-year lifetime. Likewise, for borrowers who started in 2011 and exited the FSP in 2014, the lifetime is 3 years.

04
OUTCOMES

This section shows the outcomes of the descriptive analysis, the survival analysis and estimation of the savings mobilization, forgone loan portfolio growth, and operational expenses as a result of customer exit.

4.1. LOAN AND SAVINGS MOBILIZATION

Table 1 shows the summary of savings and loan data for different segments of depositors and borrowers. Most depositors are female, married, older than 25 years, and live outside Phnom Penh. As of 2015, nearly 97.5 percent of depositors have only a savings account and only 2.5 percent have both savings and term deposit accounts. While women have equal access to financial services in Cambodia (see Section 2), the savings amount differs greatly by gender, with men on average ($1,041) saving almost three times as much as women ($383). This difference surpasses the income gap of 27 percent existing between men and women in Cambodia (WEF, 2017), and is also caused by women's inclination towards informal savings and their higher participation in vulnerable and informal employment, which are part of wider gender norms in Cambodia. Depositors in Phnom Penh have on average savings of $3,707, much higher than those living outside Phnom Penh ($334). Older adults (age ≥25 years) have on average saved $600 compared with savings of $461 for young depositors (age<25 years). The average saving balance is particularly high at FSP C ($1,676), because it has targeted higher income market segments.

Customers with both savings and loans had much lower savings balances of $43 compared with the $1,141 for customers with only a savings account and the savings accounts they held were more likely to be passive accounts (74 percent compared with 64 percent). This is because many customers were given credit-linked savings accounts which had a significantly higher proportion of passive savings accounts (72 percent) compared with those customers who initially started with a voluntary savings product (45 percent). These credit-linked savings accounts did not help in savings mobilization because they functioned merely as payment vehicles for repaying loan instalments, rather than to store monetary value.

Analysis of savings accounts reveal that nearly 70 percent of the depositors did not mobilize savings beyond $5. As of 2015, women (75 percent) and older adults (72 percent) have a significantly higher proportion of passive accounts compared with men (59 percent) and youth (47 percent). This is explained by women's clear preference for informal savings and older adults' tendency to save using term deposits. Women and younger people also keep savings liquid to cover for contingencies and daily expenses for household consumption. Due to lower incomes and a relative lack of financial literacy, the share of depositors with passive accounts is also relatively greater in rural areas compared with Phnom Penh (FinScope, 2015).

Most borrowers are female, live outside of Phnom Penh, are married and are older than 25 years. On average, men borrow $1,505, which is more than double the average borrowing of females ($680). Borrowers living in Phnom Penh ($2,646) borrow significantly higher amounts than borrowers

Table 1: Summary Statistics of Savings and Loan data between 2011 and 2015 by Demographics and FSPs

	DEPOSITORS %	AVERAGE SAVINGS US$	DEPOSITORS BELOW $5 SAVINGS BALANCE (%)	BORROWERS %	AVERAGE LOAN US$
Female	69	383	74	82	680
Male	31	1,041	57	18	1,505
Living in Phnom Penh	8	3,707	36	2	2,646
Living outside Phnom Penh	92	334	71	98	786
Age 18-25	8	461	42	5	647
Age 26-35	26	441	64	25	858
Age 36-45	26	548	71	28	862
Age 46-55	22	620	74	25	818
Age >55	18	880	75	17	793
FSP A	12	391	67	31	343
FSP B	68	386	86	36	980
FSP C	15	1,676	8/50*	10	2,725
FSP D	4%	447	19/73*	23	368
Customers with loan & savings	100	43	74	100	1,856
Customers with only deposits	100	1,141	64	0	-
Customers with only loans	0	-	-	100	469
Total	**100**	**589**		**100**	**827**

* This FSP has higher minimum account opening and ongoing balance requirements.
If the passive accounts limit is set at $15 the share of passive savings accounts would be 50% and 73% respectively.

outside of the capital city ($786). In terms of age, youth receive lower individual loans than older adults. FSP C offers larger loans ($2,725) than the other three FSPs, which offer loans in the range of $300 to $1,000.

Table 2 shows the number of borrowers increased annually by 25 percent from 424,088 in 2010 to 956,341 in 2015. The average loan size grew rapidly from $394 to $1,331 and an increasing share of borrowers accessed

individual loan products. The number of depositors at the four FSPs grew rapidly from 45,353 in 2010 to 890,248 in 2015, but this growth was accompanied by a rapid increase in passive savings accounts from 23 percent in 2010 to 70 percent in 2015. Average annual savings increased between 2010 and 2012 from $668 to $1,065 but fell in later years to $579 in 2015 due to the increasing proportion of passive accounts. So why were so many savings accounts not being actively used?

Table 2: Summary of Yearly Savings and Loan Data

YEAR	NUMBER OF DEPOSITORS	AVERAGE SAVINGS IN US$	% OF SAVINGS ACCOUNT < $5	NUMBER OF BORROWERS	AVERAGE LOAN IN US$	% INDIVIDUALS LOANS DISBURSED
2010	45,353	668	23	424,088	394	42
2011	73,527	1,084	35	559,641	502	43
2012	143,379	1,065	50	695,168	593	43
2013	398,536	466	75	823,364	722	44
2014	684,150	515	74	891,113	976	45
2015	890,248	579	70	956,341	1,331	49

To look into this, savings mobilization is analysed by gender and age across different provinces in Cambodia. Figure 5 below demonstrates that female depositors have a higher proportion of passive accounts than men across most provinces of Cambodia, as shown by the larger red slices on the left-hand figure.

Men mobilize savings better than women in most provinces of Cambodia (as shown by the larger yellow slices on the right-hand figure). Similarly, Figure 6 demonstrates that older adults have a significantly higher proportion of passive accounts than youth across most provinces of Cambodia.

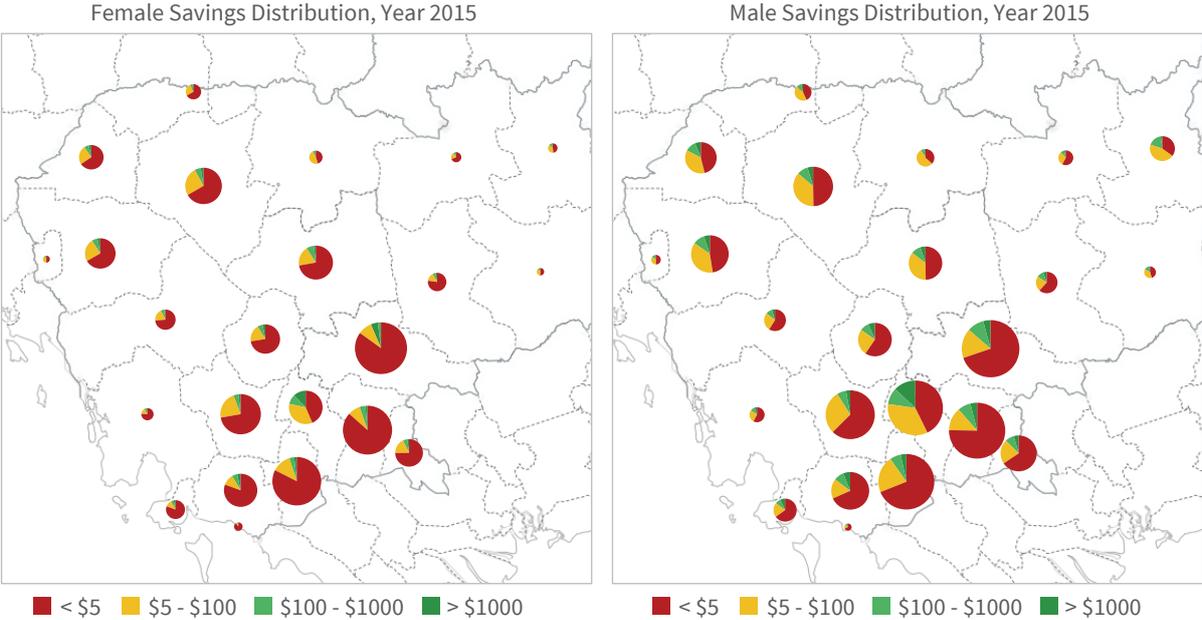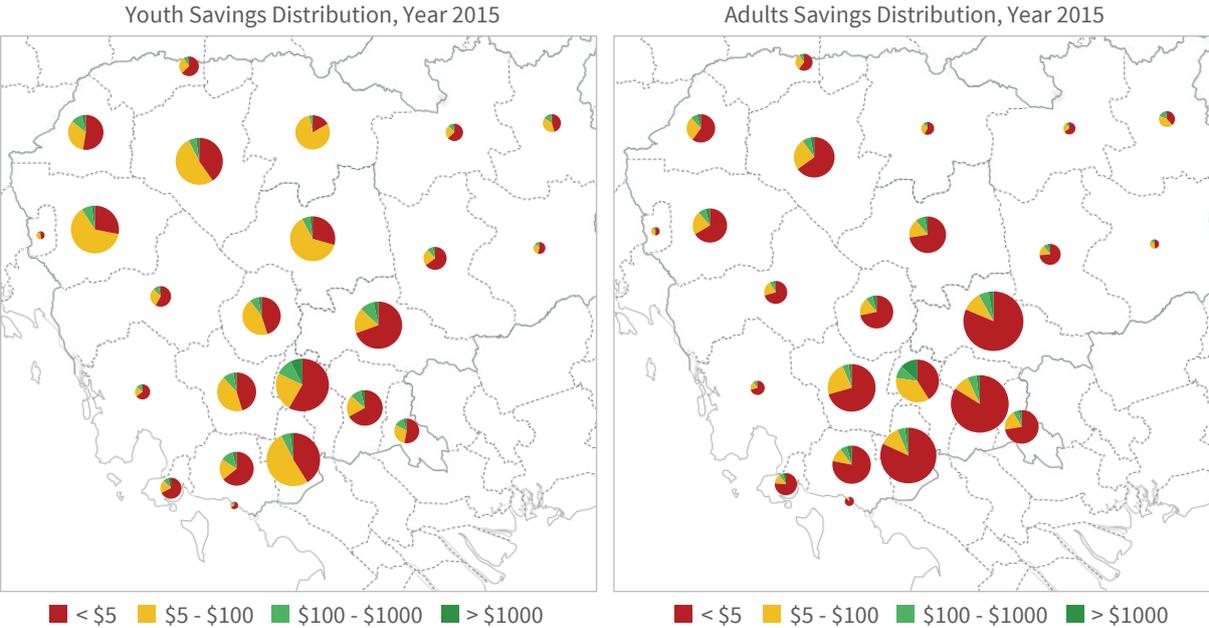Figure 5: Gender Gap in Savings Distribution Across Different Provinces in 2015

Female Savings Distribution, Year 2015   Male Savings Distribution, Year 2015

■ < $5   ■ $5 - $100   ■ $100 - $1000   ■ > $1000   ■ < $5   ■ $5 - $100   ■ $100 - $1000   ■ > $1000

Figure 6: Youth Gap in Savings Distribution Across Different Provinces in 2015

Youth Savings Distribution, Year 2015   Adults Savings Distribution, Year 2015

■ < $5   ■ $5 - $100   ■ $100 - $1000   ■ > $1000   ■ < $5   ■ $5 - $100   ■ $100 - $1000   ■ > $1000

*Note the pie charts show the distribution in terms of number depositors with passive, small, medium and large savings accounts. The larger the pie the more depositors were in this province.

There is a significant gender gap in average loan and savings amount mobilised that has widened over time to $628 for savings and $1,013 for individual loans in 2015. This gender gap in financial service usage can be explained by wider gender inequalities in incomes, access to assets and employment activities in Cambodia as well as societal norms (see e.g. ADB, 2013). Women earn on average 27 percent lower income than men in similar positions and they have lower labour force participation ratios—75 percent compared with 87 percent for men. 70 percent of the women work in vulnerable employment, often in the informal sector and as own account or family workers (WDI, 2016; WEF, 2017). Women also have lower education opportunities, with lower literacy levels. Financial literacy among women in Cambodia is among the lowest in the ASEAN region with only 16 percent of the female adults being able to understand fundamental concepts of interest rates, inflation and risk diversification (Hasler and Lusardi, 2017)

FinScope (2015) further finds that collateral requirements are a significant constraint for women's access to credit in Cambodia with more females (32 percent) than males (12 percent) not able to provide collateral as a reason for loan refusal. Youth also received lower individual loans compared to adults ($444), which is partly explained by the lack of credit history and collateral, insufficient identity documents, and lack of business skills and experience.

Figure 7: Average Savings Mobilization by Gender
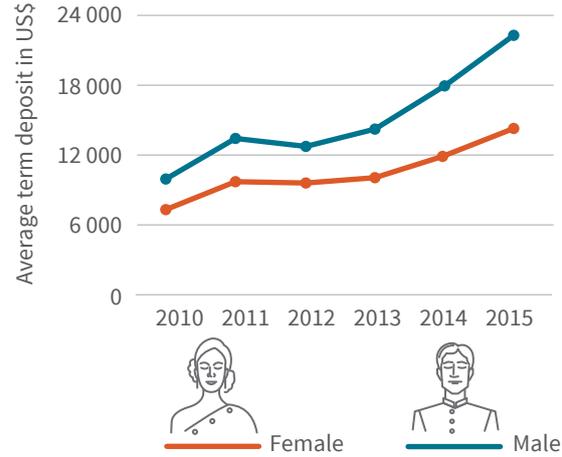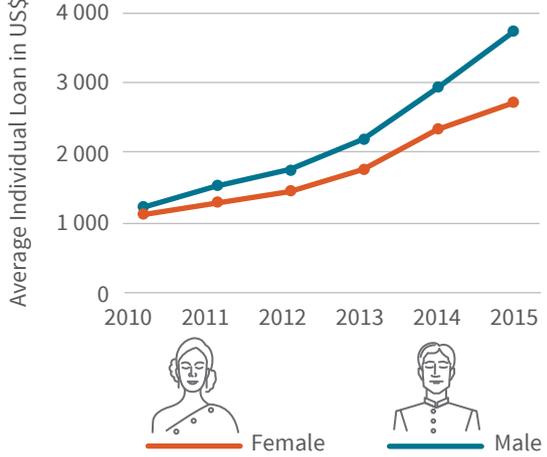a) Average Savings Accounts Balance in US$
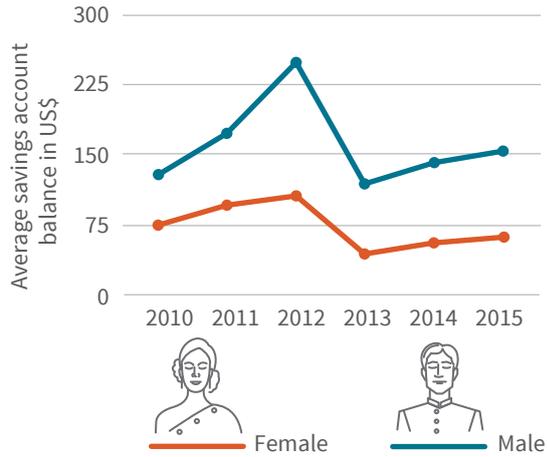
b) Average Term Deposit in US$
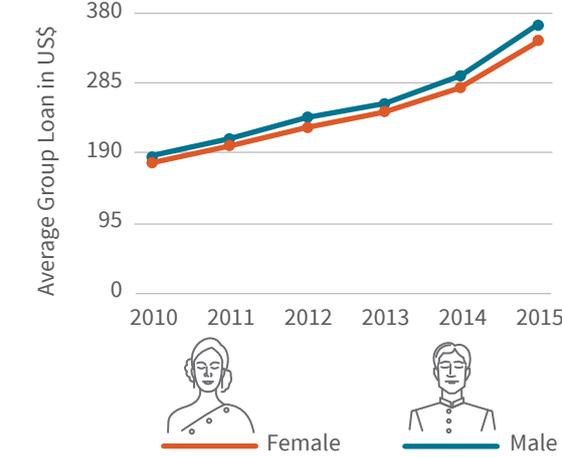

Figure 8: Average Loan Mobilization by Gender
a) Average individual loan amount in US$

b) Average group loan amount in US$

4.2 LENGTH OF THE CUSTOMER JOURNEY AND EXIT RATES

Following the survival analysis methodology described in Section 3, Figure 9 shows the cumulative failure rates of depositors and borrowers. The horizontal X-axis shows the number of years since customer onboarding; the Y-axis shows the cumulative exit (or failure) rate of savings accounts, becoming passive and staying below $5.[1] Figure 9 shows that it is important for FSPs that savings are mobilized in the first year, because this is when the majority of savings accounts become passive. Around 65 percent of the savings account holders had not mobilized savings beyond $5 to their accounts in their first year and the rate of becoming passive increases gradually to 75 percent in the fifth year.

Among the key reasons for a significant share of passive savings accounts in Cambodia is customers' limited awareness of savings account ownership, lack of financial literacy, limited access points in rural areas, and preference for informal savings. FinScope Cambodia survey data demonstrates that nearly 60 percent of adults are unaware of formal saving methods, 54 percent cannot reach a bank within 30 minutes, and 33 percent find informal savings more convenient compared with only 10 percent for formal savings. Among informal savers,

nearly 50 percent saved to engage in business or farming activities, indicating they deliver higher returns than savings in the bank. In addition, the majority of Cambodians have a relatively low monthly income ($245) and are often left with small savings after accounting for spending on consumption. Cambodia has a strong informal savings culture, especially among women, with people using 'tong tings' (a type of rotating savings group) and savings in cash or in livestock.

As mentioned, one key reason for the relatively high share of passive savings accounts is because savings were linked directly to loan accounts. Those accounts then functioned as payment vehicles for repaying loan instalments, rather than to store monetary value. A second factor mentioned by FSP experts was that internal incentive systems are geared towards opening new savings accounts, but not towards optimizing savings mobilization. FSP staff are appraised based on promoting savings access (e.g. total number of accounts opened, and total amounts mobilized), rather than on the use of savings accounts. Sometimes monetary discounts are given to new customers if they also open a savings account. This leads many customers to own multiple savings accounts, sometimes for several family members and/or for different currencies.

Figure 9: Exit Rates of Borrowers and Depositors
a) Depositors failure rate
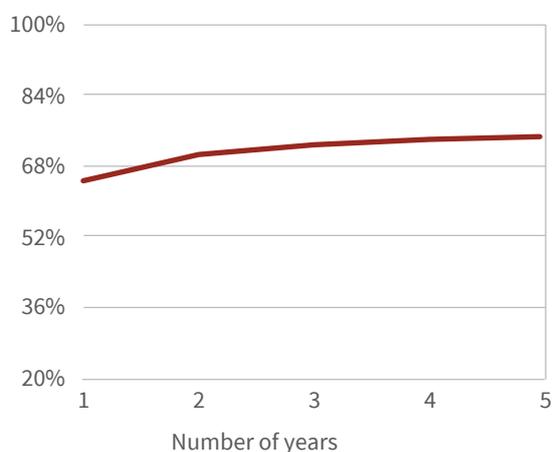
b) Borrowers failure rate
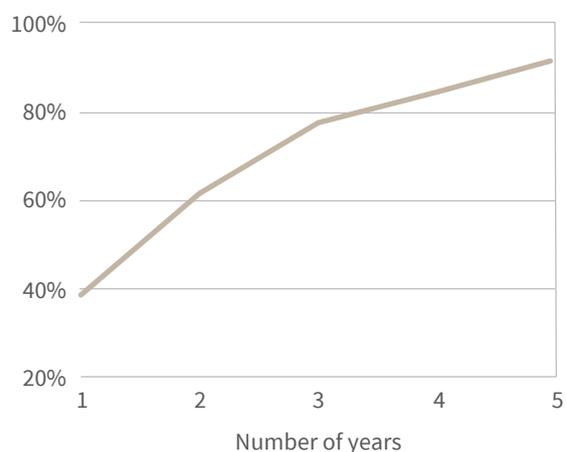
The third factor mentioned was a lack of trust in the financial sector overall. The deposit guarantee system is currently being developed by the National Bank of Cambodia to increase public confidence and help mobilize more savings.

Figure 9b shows that 39 percent of borrowers exit FSP loan programmes after the first year and that after three years most of the borrowers (78 percent) have exited the loan programme, climbing to 92 percent after five years. The survival analysis shows a limited long-term borrowing relationship between the FSPs and their credit clients. Such short borrowing relationships can be caused by a number of factors, including strong competition and by the fact that customers do not need further loans. As a related issue, in some market segments there are warnings of market saturation and over-indebtedness, which results in people cross-borrowing from multiple FSPs (Mimosa, 2015). Indeed, 89 percent of adults find managing their personal finances stressful, and 50 percent of the adult population claim to spend more money than is available to them (FinScope, 2015). Furthermore, FSPs also considered that internal factors like loan size and loan approval duration play a crucial role in retaining borrowers.

Figure 10a demonstrates that women have a significantly higher chance of becoming dormant than their male counterparts. There is a considerable gender gap in terms of passive savings accounts, which varies from 14 percent in the first year to 11 percent in the last year. In the first year, 69 percent of women stopped saving beyond $5 compared with 55 percent of men.

In the first year, 45 percent of men exited the borrowing relationships compared with only 37 percent of the women. This gender gap of 8 percent then becomes smaller after the third year, narrowing to 2 percent (See Figure 10b). Thus, while women received lower loan amounts compared with male borrowers, they actually show a better rate of customer retention.

As shown in Figure 11a, older customers (>25 years) are more likely to have passive savings accounts than young customers aged 18-25 years. Within the first 12 months, young people aged 18-25 years had a much lower passive savings account rate (31 percent) than older adults (ranging from between 63-73 percent across different age brackets). On average, the youth gap in passive savings accounts is around 37 percent. Younger people may be more aware of savings products and are more financially literate than older people.[2] Another reason for high passive accounts among older adults could be that older adults often tend to save using term deposits, while younger people

Figure 10: Exit Rates by Gender for Depositors and Borrowers
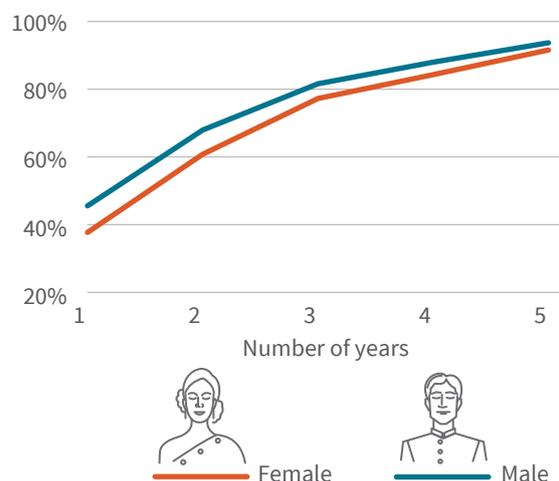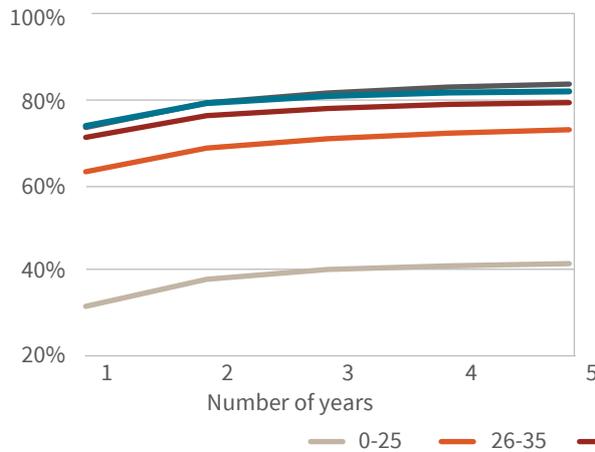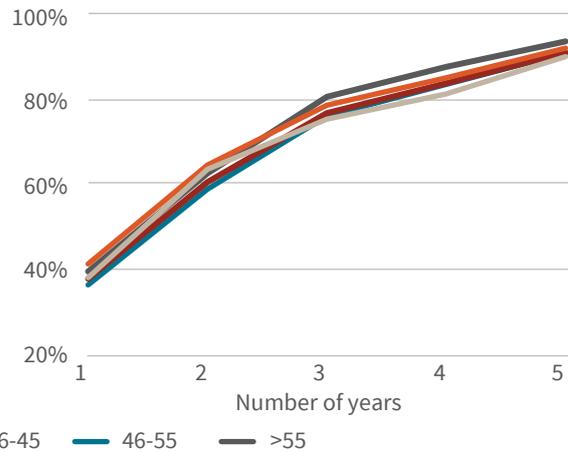
a) Depositors failure rate
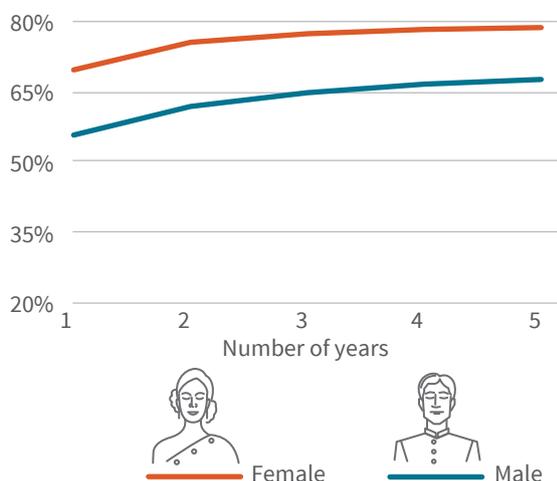
b) Borrowers failure rate

Figure 11: Exit Rates by Age for Depositors and Borrowers

a) Depositors failure rate

(b) Borrowers failure rate

Legend: 0-25 | 26-35 | 36-45 | 46-55 | >55

For example, FinScope (2015) data indicates that 60 percent of young people (<30 years) claim to need more information on savings compared with 70 percent of older adults (>60 years).

keep more liquid savings accounts to be able to cover contingencies and daily expenses. There is not much difference in exit rates between young and old borrowers. Figure 11b does show that older borrowers are slightly more likely to exit the borrowing relationship, but this is far from surprising given that for several FSPs the maximum age for borrowing is 60 years.

Interestingly, there is a much smaller gender gap in passive savings accounts among youth aged 18-25 years (2-3 percent) compared with older people (11-14 percent). Young women also have higher savings than young men (+$177 on average). These findings suggest that FSPs could benefit by promoting savings products among young women. In terms of borrower exit, there is no significant difference in the gender gap between younger and older adults.
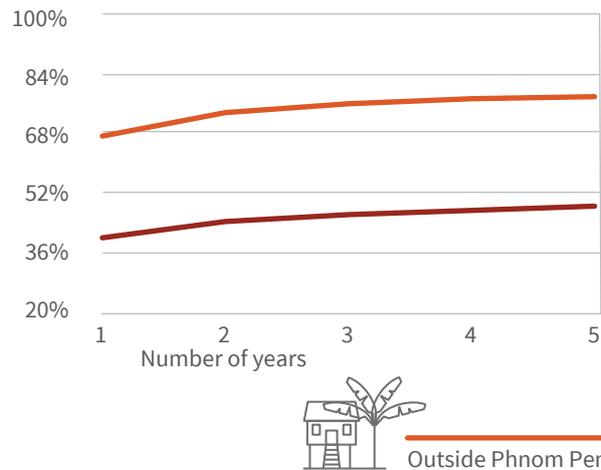
Figure 12a shows that savings mobilization outside Phnom Penh appears much more challenging than within the capital city. In Phnom Penh 50 percent of the depositors' accounts become passive within five years compared with around 78 percent in the other provinces. As a result, savings mobilization remains disproportionately confined to the capital city; in 2015, the four FSPs mobilized

$627 million (48 percent of the total deposit portfolio) in Phnom Penh alone, while the remaining 24 provinces mobilized only $690 million combined (52 percent). Indeed, access to branches is a challenge in rural areas, with 69 percent of the people in rural areas saying they cannot reach a bank in under 30 minutes, compared with 38 percent in Phnom Penh (FinScope, 2015). Moreover, the savings sector in the rural areas is not well linked to the payments sector, which reduces the attractiveness of savings accounts. Payments providers predominantly offer only cash-in and out payments, with very few people depositing payments into a savings account.[3] Mobile wallets can store value, thus allowing clients to hold savings, but regulations currently prohibit interest on such balances. Consequently, customers generally must deposit and withdraw in cash at branches, lowering the flexibility and convenience factor of savings accounts and thus making them less attractive

Furthermore, savings accounts are often not linked to regular income streams such as pension and wage incomes. Only 2 percent of the population receive their income directly in their bank account compared with 92 percent of people who receive it in cash. Interestingly,

Figure 12: Exit Rates across Phnom Penh vs. Other Provinces

a) Depositors failure rates

b) Borrowers failure rates

Outside Phnom Penh
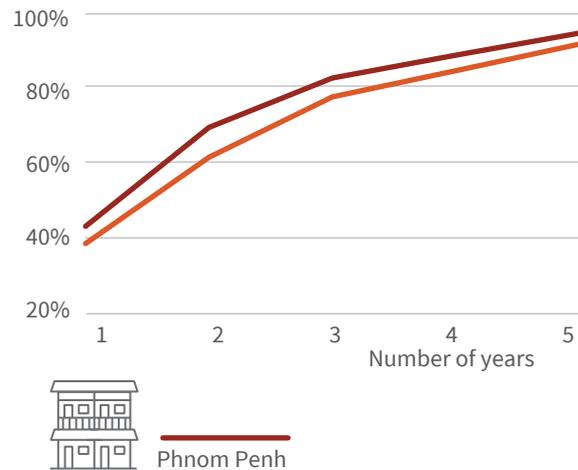
Phnom Penh

around 20 percent of Cambodian adults claimed to want to open a bank account to receive their salary, indicating salary payments could be a trigger for savings mobilization.

Borrower exit, on the other hand, is marginally higher in Phnom Penh than in other provinces. A year after taking credit, in Phnom Penh 43 percent of borrowers had exited FSPs compared with 39 percent in other provinces (Figure 12b). Higher exit rates in Phnom Penh could be due to more intense competition, which gives borrowers more opportunities to take credit elsewhere. Lower exit rates outside Phnom Penh could function as an incentive for FSPs to offer credit in more remote areas.

Women outside Phnom Penh have a higher rate of passive savings accounts compared with men, with gaps of between 11 and 14 percent over the five year period, while in the capital city the opposite is observed and women actually have a lower passive savings account rate than men (between 3 and 5 percent less; see Figure 13a). The gender gap in borrower exit rates was similar inside and outside the capital.

Figure 14 compares the customer exit rates across different product types such as regular savings accounts, term deposits, individual and group loans. Within five years, around 78

percent of the open savings accounts become passive compared with only 18 percent of term deposit accounts. Most term depositors in Cambodia are saving for the long-term (>5 years) and have much stronger customer journeys. Term deposits are generally used to accrue interest over a longer period of time (around 6-12 months), thus requiring a longer-term commitment from customers. Furthermore, these long-term accounts seemed to be renewed quite often, suggesting they are attractive for customers. Thus, it might be good practice to promote commitment savings accounts. Borrowers' exit rates are slightly lower for customers with group loans (38 percent) compared with individual loans (43 percent) in year one, which could be because of the peer pressure in the solidarity group lending models. (Figure 14b).

As in many countries, microfinance group loans seem more popular among women, while individual loans have a higher rate of uptake among men. Nearly 60 percent of female borrowers took a group loan and only 40 percent took an individual loan; among male borrowers, 55 percent took an individual loan against 45 percent taking group loans. Figure 15 demonstrates that over both the short term and the long term, women are more loyal borrowers than men. After one

Figure 13: Deposit Failure Rates across Phnom Penh vs. Other Provinces by Gender

a) Outside Phnom Penh

Female Outside Phnom Penh — Male Outside Phnom Penh

b) Phnom Penh
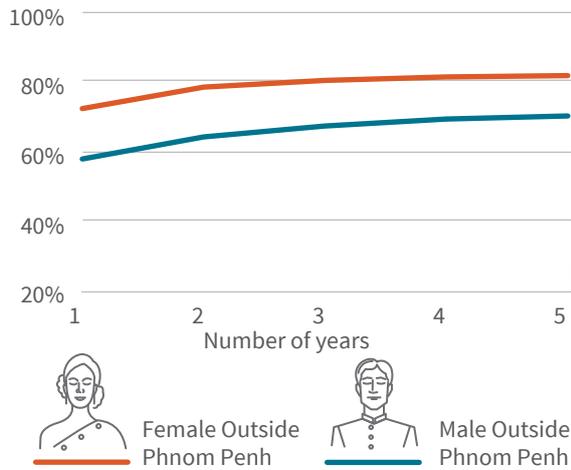
Female Phnom Penh — Male Phnom Penh
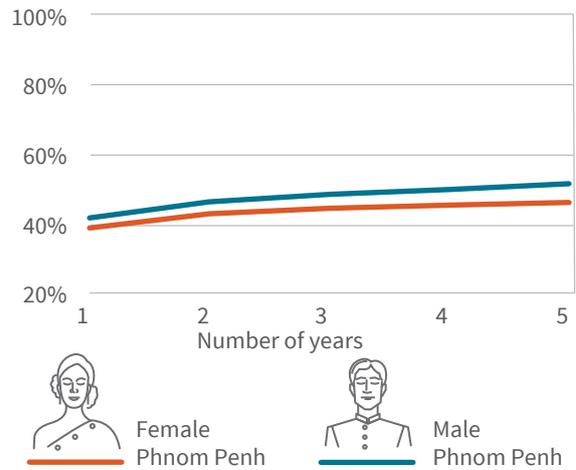
Figure 14: Exit Rates across Type of Product

a) Depositors failure rates

Savings account — Term Deposit

b) Borrowers failure rates
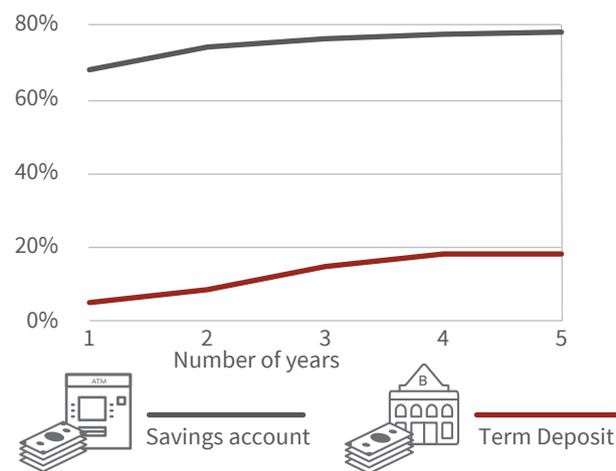
Individual loan — Group loan
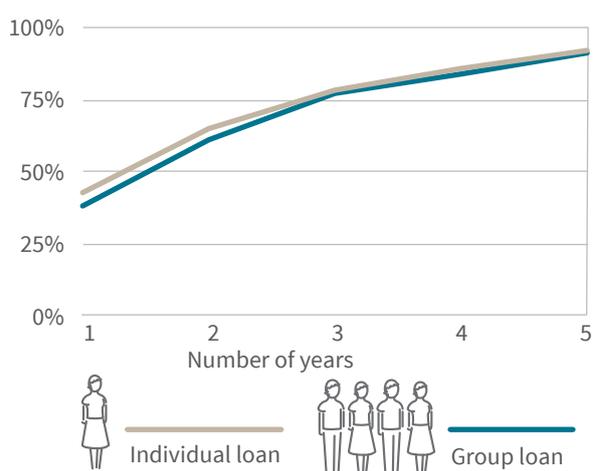
Figure 15: Exit Rates by Type of Credit Products and Gender

Individual loan Female — Individual loan Male

Group loan Female — Group loan Male
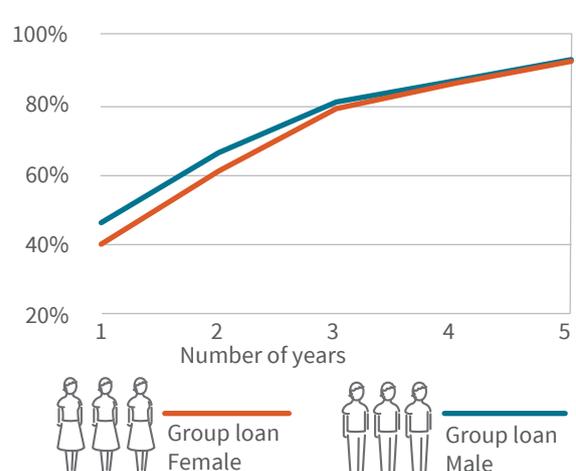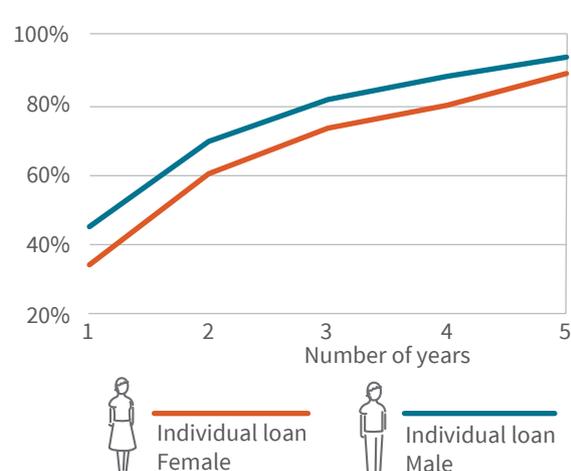
year, only 37 percent of the women with group loans stopped borrowing compared with 45 percent of men. Similarly, only 41 percent of females with individual loans exited FSPs after the first year compared with 46 percent of male borrowers.

As shown in Figure 16a, older depositors generally have significantly higher passive savings accounts rates (74 percent after one year) compared with younger depositors (32 percent). However, we find that older depositors have savings balances ($597) almost 1.5 times larger than youth ($381) and use term deposits more often. It seems that older adults mobilize savings for the long-term to cover future risks while youth keep savings liquid to cover present expenses. Youth with individual loans are less likely to exit FSPs than older people. Figure 16b shows that after one year 36 percent of young individual loan borrowers stopped borrowing compared with 43 percent of older adults. Exit rates were similar between young and older borrowers for clients having group loans.

Considerable differences in borrower exit rates were found between the top performing FSP (D) and the weaker performing FSP (B) (24 percent) (Figure 17), indicating FSP D sustains portfolio growth more cost-effectively. FSPs also have different rates of success on individual and group loan programmes. These differences suggest organization-specific factors such as customer targeting strategy, product delivery and pricing models, and customer services have an impact on customer willingness to commit to long-term financial services usage within a particular organization. Borrower exit is not only determined by external market competition but can be reduced by the FSPs themselves.

Having conducted detailed analysis on passive savings accounts and borrower exit rates, Figure 18 summarizes the general profile of depositors and borrowers with stronger customer journeys, i.e. those with lower

Figure 16: Exit Rates by Type of Savings Products and Age

a) For savings accounts and term depositors
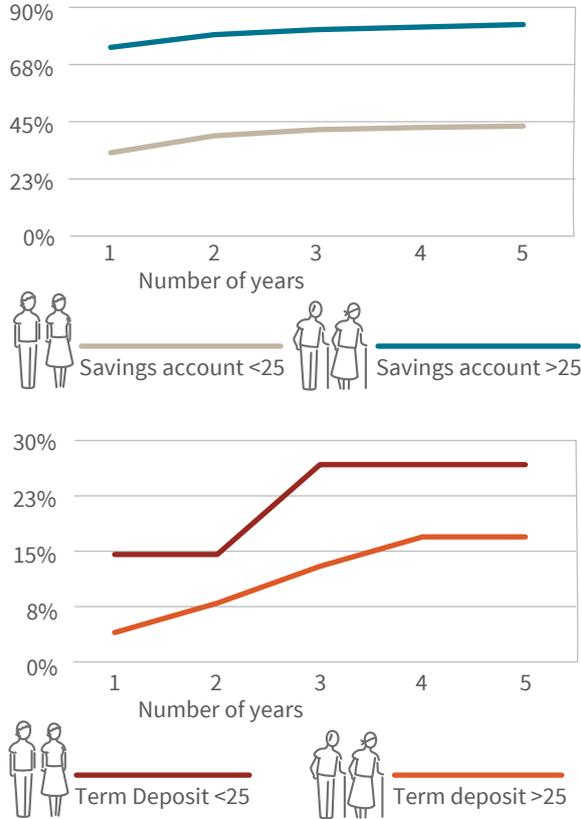
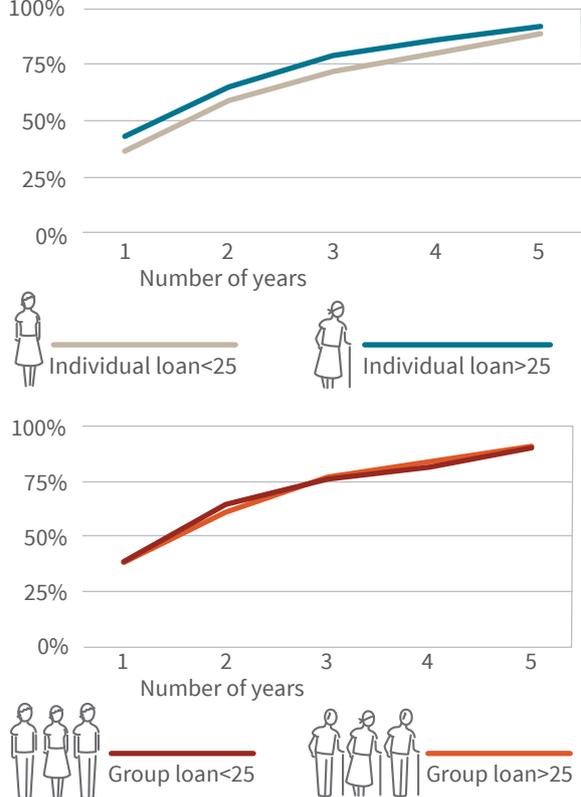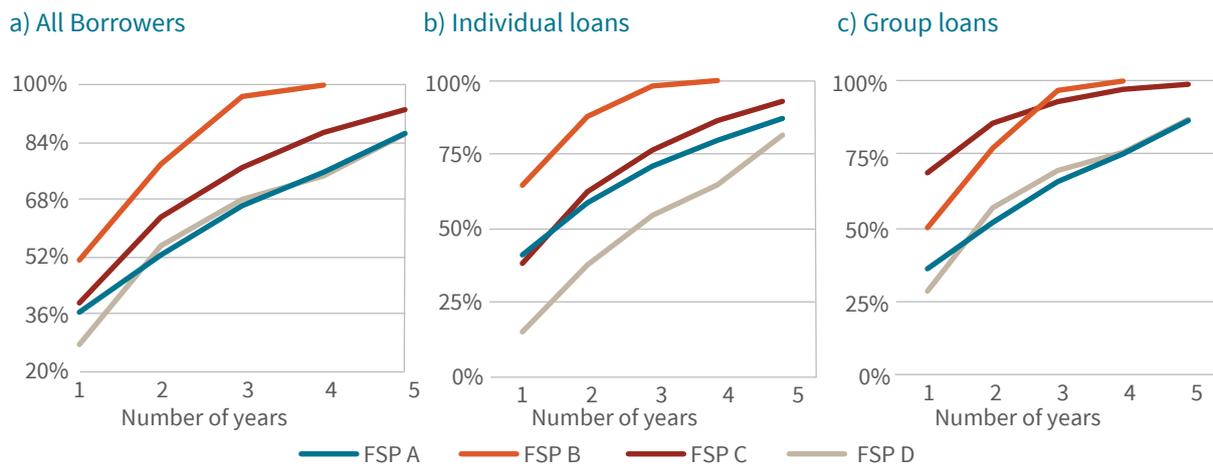b) For individual loan and group loans

Figure 17: Exit Rates across FSPs and Type of Loan

a) All Borrowers

b) Individual loans

c) Group loans

Legend: FSP A, FSP B, FSP C, FSP D

chances of letting an account become passive and exiting a borrowing relationship with an FSP. A typical long-term active depositor is a young male living in Phnom Penh who has a term deposit and saves at FSP C. On the other hand, a long-term borrower is a young female living outside Phnom Penh who has a group loan and borrows from FSP A and FSP D.

We also estimated the savings and mobilization of customers by the length of their journey with FSPs (see Table 3). A "lifetime in years" of zero represents the start of the customer journey or the onboarding year, and a "lifetime in years" of five indicates customers remaining active for five or more years. The average amount

of savings at the start of a customer journey for open savings accounts was $174; short-term savers who saved at least one year had an average balance of $453, and in five years savings almost doubled to $820 for long-term active depositors on average. Similarly, term depositors started with an average opening balance of $10,813 which increased to $29,116. This clearly demonstrates that depositors with long and active journeys at FSPs mobilize higher savings. A steady increase in individual loans ($1,230 to $1,437) and group loans (from $206 to $361) during the lifetime of borrowers (1-5 years) shows that the borrowers staying for a longer period with FSPs are likely to take up higher loan amounts than those who exit earlier.

Table 3: Savings and Loan mobilization by Length of Customer Journey

LIFETIME IN YEARS	NO. OF DEPOSITORS AT RISK	AVERAGE OPEN SAVINGS ACCOUNT BALANCE IN US$	AVERAGE TERM DEPOSIT IN US$	NO. OF BORROWERS AT RISK	AVERAGE INDIVIDUAL LOAN IN US$	AVERAGE GROUP LOAN IN US$
0	326,405	174	10,813	1,389,627	1,230	206
1	61,514	453	18,779	779,856	1,297	261
2	29,027	656	19,149	407,115	1,345	295
3	13,070	746	19,931	187,889	1,454	317
4	6,100	902	26,801	92,674	1,437	315
5	5,959	820	29,116	50,563	1,291	361

Figure 18: Profile of Depositors and Borrowers with Strong Customer Journey

DEPOSITOR	BORROWER
Male	Female
< 25 years old	< 25 years old
Lives in Phnom Penh	Lives outside Phnom Penh
Saves at FSP C	Borrows from FSP A and FSP D
Takes term deposit	Takes group loan
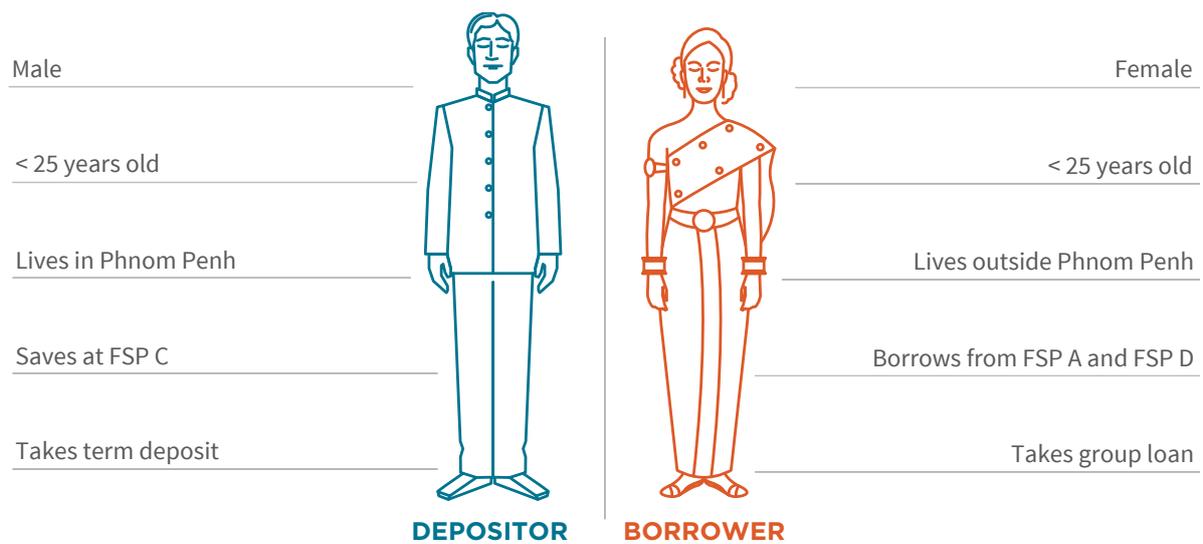
4.3 BUSINESS CASE FOR IMPROVING CUSTOMER JOURNEYS AT FSPS

According to several FSPs, the cost of opening a savings account is significant because of the KYC checks, the staff time (15-30 minutes) required to register the account, and because depositors sometimes have to visit the branch twice to complete registration. Often a minimum deposit of less than $5 is required from the customers, covering only part of the customer acquisition costs. While there is a marginal cost of maintaining dormant savings accounts for FSPs, the closure procedures are difficult and costly. Borrower exit can be equally expensive. Some studies estimate it is at least five times costlier to acquire a new borrower than to retain an existing one (Churchill, 2002). The cost of screening retained borrowers is substantially lower because transaction costs decrease for follow-up loan cycles as records of repayment and other information is available, and borrowers may take up other products from the FSP (Churchill, 2002; Copestake, 2002).

Estimating the forgone opportunities caused by passive savings and high borrower exit rates provides another way of measuring the business case for strengthening customer journeys. In 2015, the four FSPs in this study mobilized $515 million of savings from 890,248 depositors, with an average savings amount of $579 per depositor. Since 70 percent of the depositors have passive accounts, 30 percent of the depositors (267,074) have mobilized almost all the savings. Table 4 shows the estimated total savings mobilization if the number of passive savings accounts were reduced by 10 percent, 20 percent and 30 percent. The table shows the amount in additional deposit portfolio that would have to be mobilized by the four FSPs if passive savings accounts decrease by 10 percent to 30 percent. The reduction in number of passive accounts can be achieved by attracting the small savings of informal savers into the formal banking system. Given an average deposit of $579 it is estimated that reducing passive savings by 10 percent could have mobilized an additional $52 million worth of savings into the four FSPs. Similarly, decreasing passive savings by 20 percent and 30 percent could have mobilized an additional $103 million and $155 million respectively.

From a public policy case, reducing the number of depositors with passive accounts can improve the financial inclusion rates of the entire microfinance sector. In 2016 there were in total 1.5 million depositors in the microfinance sector of Cambodia

Table 4: Forecasting Forgone Savings Mobilization

	% OF DEPOSITORS BELOW $5	NO. OF DEPOSITORS WITH ACTIVE ACCOUNTS	NO. OF DEPOSITORS WITH PASSIVE ACCOUNTS BECOMING ACTIVE*	FORGONE SAVINGS IN MILLION $ (WITH AVERAGE SAVINGS OF $ 579)
Business-as-usual	70	267,074	0	0
Scenario 1: Reducing depositors with passive accounts from 70% to 60%	60	356,099	89,025	52
Scenario 2: Reducing depositors with passive accounts from 70% to 50%	50	445,124	178,050	103
Scenario 3: Reducing depositors with passive accounts from 70% to 40%	40	534,149	267,075	155

* Calculated by subtracting the number of new passive accounts from old passive accounts. For example, if passive accounts decrease by 10% i.e. from 70% to 60%, additional active accounts at four FSPs would be 890,248* 0.1 = 89,025

(NBC, 2016) and following the data insights of this paper, the majority—70 percent, or almost 1 million depositors—are likely to be passive savers. Assuming the sector manages to reduce the percentage of passive accounts from 70 percent to 40 percent, this would transition 450,000 people from saving access to use. If in addition the growth in number of new depositors is 5 percent per annum over the period 2016 to 2022, then 300,000 people would start using new deposit services, the majority of whom are likely to be women who would otherwise save in the informal sector.[4]

Table 5 estimates the additional loan mobilization at four FSPs if the yearly borrower exit rates decrease by 5 percent, 10 percent, and 15 percent respectively, from an historical average exit rate of 39 percent[5] at FSPs. With a reduction in yearly exit rates from 39 to 34 percent (5 percent), four FSPs would have retained around 169,669 borrowers who might otherwise have exited between 2011 and 2015, resulting in $152 million in additional credit mobilization. Similarly, with a 10 to 15 percent decrease in exit rates, the four FSPs would have mobilized $304-$607 million in additional credit.

Acquiring new borrowers in microfinance is costly because smaller loan sizes require relatively high customer acquisition transaction costs. In the context of the interest rate cap set at 18 percent for the microfinance sector, improving borrower retention is a way to contain operational expenses (Rovjay, 2017). The MIX Market data on the four FSPs in the study finds that during 2011-2015 the operating expenses per borrower varied between $75 and $136. Previous studies on customer retention suggest that acquiring a new customer is at least five times more expensive than retaining an existing one. Table 6 shows the number of borrowers leaving the four FSPs each year, yearly operating expenses per borrower and cost benefits if four FSPs reduced the yearly exit rates by 5 percent, 10 percent, and 15 percent. We estimate that reducing the yearly exit rates by 5 percent would have saved $27 million for the four FSPs between 2011 and 2015. Similarly, reducing the yearly exit rates by 10 percent and 15 percent could have saved $54 million and $108 million respectively.

Table 5: Forgone Loan Mobilization

	YEARLY EXIT RATE	NO. OF BORROWERS EXITING FROM FOUR FSPS WHEN EXIT RATE IS 39%	NO. OF ADDITIONAL BORROWERS RETAINED WHEN EXIT RATE IS REDUCED BY 5%, 10% AND 15%	AVERAGE LOAN SIZE IN $	FORGONE LOAN MOBILIZATION DURING 2010-15 IN MILLION $
Business-as-usual	39	1,323,416	0	827	0
Scenario 1: Reducing yearly borrower exit rate from 39% to 34%	34	1,323,416	169,669	827	152
Scenario 2: Reducing yearly borrower exit rate from 39% to 29%	29	1,323,416	339,337	827	304
Scenario 3: Reducing yearly borrower exit rate from 39% to 24%	24	1,323,416	509,006	827	456

Table 6: Cost of Borrowers' Exit to FSPs

YEAR	AVERAGE COST PER BORROWER (US$)	TOTAL NUMBER OF EXIT BORROWERS	COST BENEFIT BY REDUCING YEARLY EXIT RATE BY 5% (IN US$MN)*	COST BENEFIT BY REDUCING YEARLY EXIT RATE BY 10% (IN US$MN)	COST BENEFIT BY REDUCING YEARLY EXIT RATE BY 15% (IN US$MN)
2011	75	159,702	2	5	10
2012	51	209,892	2	4	9
2013	100	288,894	6	12	23
2014	112	262,600	6	12	23
2015	136	397,859	11	22	43
Total cost			**27**	**54**	**108**

* The cost reduction is simply measured by taking the number of extra borrowers that were retained (5%) and multiplying this by the average cost in US$ in the given year.

1　For better visualization, the graph starts at year one (t=1) because all the customers were active at t=0 and so the failure or exit rate at t=0 is 0% by definition.

2　For example, FinScope (2015) data indicates that 60 percent of young people (<30 years) claim to need more information on savings compared with 70 percent of older adults (>60 years).

3　Most microfinance deposit-taking institutions are not allowed to do interbank transfers, which also makes savings products less convenient for account users when they want to transfer money to another bank.

4　The 5 percent annual growth would lead to 0.5 million new depositors over the period 2016 to 2022. In the current situation at 70 percent passive accounts, only 150,000 would take up savings. If the percentage of depositors with passive accounts were only 40%, this would be 300,000.

5　Yearly exit rate = Number of borrowers leaving FSP during a year divided by total of borrowers at the start of year. For example, if 100 borrowers are present in 2011 at a FSP and 40 borrowers leave the same year, the exit rate during 2011 is 40 percent.

05

RECOMMENDED SOLUTIONS TO IMPROVE CUSTOMER JOURNEYS

Having highlighted customer journey patterns as well as the business case for strengthening them, this section sets out a selective set of fintech and digital finance solutions that can improve customer journeys by lifting some of the barriers to the transition from access to use of financial services. As mentioned, key barriers to low savings mobilization and factors which encourage the high presence of passive savings accounts in Cambodia include the attractiveness and convenience of informal savings over formal savings, limited distribution channels and limited access points in rural areas. In addition, challenges especially affecting women clients include limited linkage between savings accounts and payments and regular income streams, and customers' limited awareness of savings account ownership and low financial literacy. Key barriers to reducing high borrower exit include organization-specific factors, such as weak customer assessments, limited customer loyalty programmes and a lack of customer-focussed products.

RECOMMENDATIONS FOR FSPS

Promote mobile wallets to allow more convenient formal savings:

The increased use of digital finance has helped consumers move from informal to formal savings. Mobile wallets are mobile based accounts— increasingly accessed through smart phone-based apps—that allow simple, secure and more convenient access to low-cost savings accounts, payments, insurance and loans in very low volumes. Mobile wallets allow financial service

providers to move away from product-specific approaches towards a more unified customer-oriented approach. Mobile wallets may also offer convenient alternatives to informal savings as deposits can be made in relatively low and frequent amounts, mirroring the convenience of informal savings and mitigating some of the major barriers to low-income customers to using established banks. Examples of mobile wallets in Cambodia that increasingly move from providing payments to include other services are ABA Mobile, TrueMoney, PiPay, Wing.

Tailor delivery of saving services to female customers:

To improve savings mobilization—especially among females, older adults, and rural populations—distribution networks must be in place to provide easy and convenient services. For example, the LienVietPostBank works with the Viet Nam Women's Union which offers a distribution network for its product, consolidated with accompanying gender-sensitive financial literacy workshops.

Develop delivery channels to provide better access to savings in rural areas:

In Cambodia one specific challenge is that deposits often have to be made at MDI branches. Yet nearly 50 percent of adults in Cambodia take more 30 minutes to reach a bank or MDI (FinScope, 2015). As many users of mobile wallets and savings accounts still require cash, agent networks and doorstep banking are necessary in rural areas and provide an opportunity to help

clients use all suitable available products. For example, Equity Bank in Kenya, which uses a rural agent network, mobilizes 20 percent of its deposits digitally. Likewise, the Pafupi savings accounts of NBS Bank in Malawi are opened by mobile sales agents in less than ten minutes with local agents visiting women customers in rural communities. The account holders are also given an ATM card to use for withdrawals at agent locations and at any NBS Bank ATM. Between 2015 and 2017, the number of savings accounts grew from 7,755 in 2015 to 101,268 in 2017 with the majority of them mobilizing deposits (UNCDF MicroLead, 2018).

Enable payments and domestic remittances transfers on savings accounts:

Mobile Network Operators and fintech providers can partner with banks and MDIs to ensure payments and savings can be made by customers. An example is Paytm wallet in India, which was originally a payments application but now allows users to link their mobile wallet with their savings accounts and debit and credit cards from other FSPs to access a variety of financial services.

Link savings accounts to regular income streams such as wages and pensions to turn passive depositors active:

As mentioned in Section 3, of key importance is to link savings accounts to regular income streams such as wages and pensions to enable increased savings mobilization. An example is the AMRET Family savings product, a digital e-wallet that aims to link the income streams of garment factory workers to their family savings and payment accounts.

Enhance digital financial literacy and savings product awareness among customers:

MDIs can send push messages via SMS, email or smartphone notification to existing depositors with low value savings accounts to encourage them to mobilize savings. In fact, several fintech firms are specialized in conducting real-time anal-

ysis of customers' financial data to alert dormant and low-value depositors, and cross-sell products. For example, Juntos increases savings mobilization by sending personalized messages on mobile phones and social media to dormant depositors, either reminding them or making them aware of their savings account. Another option is to design commitment savings accounts which have been effective in improving savings mobilization for women (Buvinic and O'Donnell, 2016).

Another cost-effective approach to increase product usage is through digital financial literacy applications. One example is Wave Money in Myanmar, which is designing a financial gaming application where people can learn more about financial concepts such as savings, interest payments and insurance while they play. For the majority of youth, digital financial services are likely to be their first contact with the banking sector and in this respect, there are also digital financial literacy education tools tailored to children, including mobile wallets with an educational aspect for children (such as Ernit and Bankaroo), and Money Tree that delivers on-line movies for children in Cambodia to support children's financial literacy.

Reward customer loyalty:

Design customer loyalty programmes and reduce interest rates for follow-up loans and borrowers that actively mobilize deposits. Retained customers are more cost-effective and take up larger loans and savings compared with new customers, yet pricing models or staff incentive systems of banks do not always reflect this pattern. For example, although women and youth have better customer retention, they actually receive lower loan amounts, suggesting some lending institutions may not be fully aware of their customers' behaviour. By digitizing much of the banking process and by having data on customers, lenders and account providers can offer tailored, customer-specific loyalty plans that reward loyal customers.

Experiment with alternative credit scoring:
Customer data are being leveraged to develop alternative credit scoring models by fintech firms such as Lenddo, DemystData and Cignifi who use social media, mobile phone usage, and e-commerce transactional data of customers. By using these data, banks can make more automated and informed decisions, enhancing credit access for low-income women and youth—especially in rural areas—by providing them with affordable credit in a faster and more transparent manner, making credit more accessible by negating the need to have a formal credit score or collateral. Using psychometric scoring Entrepreneurial Finance Lab and Janalakhmi Financial Services augment conventional loan applications with "subjective" data derived from clients' self-assessments on entrepreneurial skills to reduce default risks and increase financial service usage. Furthermore, credit bureau data could be supplemented to help predict over-indebtedness. Credit scoring models can be further applied to improve customer retention using predictive analytics to understand customer behavior. Examples of fintech firms working on this include Retentionscience, Feedzai, and ZestFinance.

Improve customer data assessments for product development:
Strengthening customer assessments can unlock significant benefits for FSPs, particularly in terms of improved savings services and retention, increased cross-sales of products, better risk management and stronger social performance management. For example, considerable differences between the top performing FSP and the lowest performing FSPs indicate borrower exit is under the control of the FSPs themselves. Likewise, differences in passive savings accounts across FSPs indicate that forced linking of savings and credit is not good practice. Good customer assessment is vital in improving financial service usage, while strictly protecting customers' data and privacy by implementing appropriate laws (e.g. Gramm-Leach-Bliley Act) and guidelines (see UNDG, 2017).

Data analytics software is improving and able to handle larger volumes of transaction data. In addition to using insights from Management Information Software systems and exit surveys, FSPs can also consider using low-cost software such as R-Studio and Tableau to generate customer insights for larger volumes of data and subsequently develop more appropriately designed products with higher financial service usage.

POLICY RECOMMENDATIONS FOR REGULATORS

Establish digital identity database:
Harmonizing the use of national identification cards in the MDI sector can greatly reduce the time and cost of delivering financial services in Cambodia, where 95 percent of adults are reported to have such a card (Finscope, 2015). As an example, Aadhar was established in India to target delivery of financial services and government-to-person payments such as subsidies, wages and pensions, combining these services with an "all-in-one" proof of national identity. Other countries such as Malaysia and Singapore also have multi-functional digital national identification cards for citizens (which serve the purpose of a driver's licence, an ID card, a health document and can serve as a digital wallet and a means of payment, amongst other functions), which has helped increase financial inclusion. A more standardized identification database can further support the protection of customers and help to increase the monitoring of over-indebtedness and cross lending for the FSPs and credit bureaux.

Explore regulatory technologies (RegTech):
RegTech can help to monitor the increased number of transactions and necessary KYC regulatory compliance, while strictly complying with applicable data protection laws and regulations (e.g. General Data Protection Regulation in the European Union). Examples of such technologies include IdentityMind global, Onfido, Ancoa, and AQMetrics which conduct KYC and AML fraud prevention checks. Another

interesting example in the field of customer consent to use data includes Trunomi, which provides customer data rights management technology to private sector companies. This enables businesses to request, receive and capture customer consent to use their personal data. All this enables financial service providers to comply with regulations by putting in place auditable workflows to record and prove the lawfulness of processing of customer data.

Support the facilitation of partnerships between banks and non-bank institutions and linked financial products:

Mobilize small savings, especially among women and people in rural areas. Implement policies that allow mobile wallets such as those offered by providers such as Wing and True Money to be linked with savings accounts at banks and MDIs. Allowing interest bearing on savings wallets for the Cambodian FSPs would help to incentivise the promotion and use of digital wallets. Allow MDIs to do interbank transfers with other MDIs to make savings products more convenient for account holders by allowing them to transfer money to another bank. Building an ecosystem that allows all financial institutions, banks and non-banks alike, to access each other's networks would allow customers to transact more easily and foster greater financial inclusion.

Incorporate financial service usage and customer-value insights into monitoring indicators of the National Financial Inclusion Strategy:

In this regard, segmented customer data such as by sex and youth can be used for design, implementation, and evaluation of policies aimed at improving financial inclusion and financial services usage in Cambodia.

Examine the after-effects of the interest rate cap on financial inclusion:

To offset the risks of an interest rate cap, FSPs are likely to offer higher loan sizes, lengthen the loan period, and charge higher upfront fees. Given that rural and female borrowers take up smaller loan amounts, it is likely that the number of rural and female borrowers may decline and the gender gap in loan mobilization may increase. Such repercussions of an interest rate cap are relevant in the context of a national financial inclusion strategy which focusses on the financial inclusion of women and un- and underserved (rural) populations.

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ANNEX I. TECHNICAL DESCRIPTION OF SURVIVAL ANALYSIS METHOD

Cleves et al. (2010) suggest that when covariates are qualitative, the Kaplan-Meier (KM) estimator can be used to compare the probability of failure (survival) of different groups in the data. We use Kaplan-Meier (KM) estimator—a non-parametric estimate of survival function[1]—to find the probability of failure of customers (depositors or borrowers) during a period of time. The KM survival rate until time t or longer is calculated as follows:

$$S(t) = \frac{Number\ of\ borrowers\ or\ depositors\ surviving\ until\ time\ t\ or\ longer}{Number\ of\ borrowers\ or\ depositors\ at\ the\ start\ of\ time\ period}$$

The cumulative survival probability for time t or longer is estimated using the product limit method of Kaplan and Meier (1958) and is expressed as:

$$S^{\wedge}(t) = \prod_{t_i \leq t} \left(1 - \frac{Number\ of\ borrowers\ or\ depositors\ failed\ upto\ time\ ti}{Number\ of\ borrowers\ or\ depositors\ prior\ to\ time\ ti} \right)$$

For example, the cumulative probability that a borrower survives for three years is calculated by multiplying the probability of her survival in the first year by probabilities of survival for the second and third years respectively. The cumulative probability of failure during the three years would then be one minus probability of survival for 3 or more years. The cumulative probability of failure is expressed below:

$$Cumulative\ failure\ rate = 1 - S^{\wedge}(t)$$

The cumulative failure rates for different time periods are then used to plot the failure curve. The KM estimator assumes failure only during the monitoring periods, but no failure between monitoring periods. For example, a borrower might have taken a loan in 2010 and exited the FSP in the same year, but the KM estimator will only record its exit in 2011 since the failure is monitored once every year in the data. For this reason, the failure curve is plotted as a step function (Goel et al., 2010). But since borrowers can exit MFIs any day and savings balances could go below $5 any hour, we plot failure rates in the form of line charts.

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1 Non-parametric survival models do not make any assumption on the shape of failure function or how the covariates may affect the survival curve (Cleves et al., 2010).

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