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Abstract: Permanent disequilibrium in mainstream credit markets have pushed the unbanked and underbanked households to frequent high cost payday loans for their liquidity needs. Associated with the latter are welfare-reducing issues of predation and debt-entrapment. In response to this market failure, we expound a simple model that integrates inexpensive interest-free liquidity facility within an endogenous leverage circuit. This builds on the technology of ROSCA/ ASCRA/ mutual/ financial cooperative and cultural beliefs indoctrinated in Islam. Results indicate that such a circuit moderates adverse selection and moral hazard issues more efficiently than payday loan and mainstream financier. Additionally, it does not suffer the drawbacks of welfare-reducing payday loans and also addresses financial exclusion in mainstream credit markets.

JEL codes: D14, G29, G32, 016, Z12

Keywords: interest-free loan, payday loan, financial exclusion, liquidity facility, cooperatives

I. Introduction

"*Financial exclusion is likely to act as a "brake" on development as it retards economic growth and increases poverty and inequality. .... Without access to financial services, households will not be able to invest in their human capital, smooth consumption, insure against income shocks, and save for retirement*".

Beck and Demirguc-Kunt (2007, p.1)

The Federal Deposit Insurance Corporation (FDIC) 2009 national survey of unbanked and underbanked households carries concerns on the extent of financial exclusion of American households.[1] Approximately 26% or 38 million households, consisting of 60 million adults, mostly residing in urban and rural areas, are financially excluded from mainstream credit markets. Clearly, as articulated above by Beck and Demirguc-Kunt (2007), this has negative repercussions on the households' ability to achieve financial security, impedes economic growth and creates social imbalances.

The credit market for the unbanked and underbanked household exhibits the classic case of 'permanent disequilibrium' discussed by Baltensperger (1978), caused by the twin issues of adverse selection and moral hazard, which results in a persistent credit rationing, or complete withdrawal of mainstream financiers from the market (Stiglitz and Weiss, 1981). To bridge their credit needs, these households have had to frequent high cost alternative financial service providers, or fringe banking institutions. Of particular interest to this paper is the reliance on payday loans as a financial solution for emergency and expenditure shocks.

Payday loans or cash advances, are structured to function as a short term liquidity facility to smooth inter-temporal income shocks. This involves issuance of single, small, short-term and unsecured consumer loan, ranging from $100 to $500. An average payday loan is for less than $300, with repayment period of 7 to 30 days (Elliehausen and Lawrence, 2001; Stegman, 2007). The industry has been severely criticised for its high credit cost, in

[1] According to the FDIC (2009), unbanked households are those currently without any savings or checking account. On the other hand, the underbanked are those who do have banking accounts but subscribe to the services of alternative financial service providers. Based on this categorisation, 7.7% (9 million) and 17.9% (21 million) households are unbanked and underbanked, respectively. Additionally 5 million households may potentially be underbanked but have been omitted from the above due to paucity of data on their usage of alternative financial services.

combination with wider issues of predatory practices and expropriation of wealth.[2] Undergirding these criticisms is the fact that payday loans exacerbate debt entrapment on a subset of its customers (Elliehausen and Lawrence, 2001), who are economically vulnerable (Smith et al., 2008), and lack financial sophistication (Flannery and Samolyk, 2005). The onerous fees reflects the industry's high transactional costs (Skiba and Tobacman, 2007), and severe default rates (DeYoung and Phillips, 2009).[3] Interestingly, despite heavy criticisms, there is still persistent demand for the products. Thus, this highlights a pressing need to explore inexpensive financial alternatives to assuage the liquidity needs of unbanked and underbanked population.[4] To date, studies on payday loans have either focused on (i) credit behaviours; or (ii) welfare effect of the borrowers, without delving on Pareto optimal substitutes.

Recognising this shortcoming, the primary motivation of this paper is to expound an institutional design for the provision of inexpensive, short-term liquidity facility, which satisfies the latent demand of this underserved market to smooth their inter-temporal exogenous income shocks. Specifically, our study aims to explore the following question: Can an endogenous interest-free payday loan circuit provide a more efficient credit solution in contrast to current payday lenders and mainstream financiers? This is achieved through integrating the two strands of literature on: (i) institutional structures related to endogenous circuits (such as Rotating Savings and Credit Association – ROSCA/ Accumulating Savings and Credit Associations – ASCRA); with (ii) cultural beliefs (i.e., Islamic tenets) in particular, interest-free loans.[5] Our research motivation is consistent with that of Coase

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2 Predatory lending is "*welfare reducing provision of credit*" (Morgan, 2007, p.1), characterised by "*excessively high interest rates or fees, and abusive or unnecessary provisions that do not benefit the borrower*" (Carr and Kolluri, 2001, p.1).

3 These are mainly fixed overheads, loan processing, taxes, and funding costs (Ellihausen and Lawrence, 2001). The industry's default rate of 21% is extremely risky compared to the 3% rate experienced by commercial banks (DeYoung and Phillips, 2009). We find that the high cost concurs with credit literature to compensate for risk associated with these risky borrowers.

4 Although we have used the United States as the primary reference base, this does not preclude the existence of payday lending in other developed and developing economies.

5 ROSCA and ASCRA are informal institutions, where members contribute periodically an amount of funds to a common pool over a specified period. In ROSCA, the sequence of assignment of the pooled funds to each member is either determined on a random basis or through a bidding process. By pooling resources, it permits the mobilization of funds that otherwise would have been kept out of circulation (Besley et al., 1994). Whilst ASCRA shares similar features of its nemesis, there is greater flexibility in the amount and timing of each member contribution, larger membership, allocation of the pooled funds, and its greater social function (Bouman, 1995).

(1937) and Alchian (1950), who in their seminal papers rationalise efficient institutions as those that evolve and adapt to the environment to deliver services in a cost effective manner. Moreover, the approach taken in this paper to intertwine institutional design with culture is reflective of Acemoglu et al. (2005, p.424), who reiterate "*belief differences clearly do play a role in shaping policies and institutions*".

For the purpose of this paper, the target population are economically active households. This is consistent with the underwriting criteria of payday lenders that require borrowers to be in employment, as well as with the findings of the FDIC (2009) survey. Additionally, our model is based on risk neutral economic agents. We illustrate the above through an institutional structure of an endogenous leverage circuit formed from member based contributions.[6] This is followed by two stepped extensions that assimilate real world elements of having (non)borrowers within a finite life circuit, and subsequently extending the circuit as a going concern with random repetitive (non)borrowing. The objective of the basic framework and the extensions are to solve for Pareto-efficiency. This is showcased by mathematically modelling a short term interest-free credit facility circuit that moderates agency costs of debt. The beauty of the model lies in the structuring of the circuit, where members help one another to alleviate inter-temporal liquidity shocks such that the benefits of borrowing outweigh the cost of it. This draws from the 'barn raising' practices in the United States frontiers discussed in Besley et al. (1993) and captures Commons's viewpoint (1931, p.651) where he states "*... collective action is more than control and liberation of individual action-it is expansion of the will of the individual far beyond what he can do by his own puny acts*".[7]

This paper contributes to existing literature from four perspectives. First, it averts expropriation of wealth of unbanked and underbanked households through establishing an alternative recourse for liquidity funding. This is in contrast with liquidity stripping from

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[6] We employ a generic term 'circuit' to signify all institutions where the principal and agent are the same individual. The structure is akin to that of a non-profit institution. An administrator may be present but is not incentivised by rent-seeking motives.

[7] Our model reiterates the significant developmental role of endogenous circuits in the 19th century. These circuits permit greater latitude to grant its customers affordable credit compared to profit-oriented mainstream financiers (El-Gamal, 2009). Recently, the economic importance of endogenous circuits in the United Kingdom was further boosted by the legislative reforms that enabled these institutions (i) greater market reach; and (ii) flexibility to determine its member incentive structures (see HM Treasury, 2012; Moore, 2012).

onerous interest charges of current payday loans that self-reinforces the already poor economic status of these households. Second, our framework allows the casting of financial inclusion to also include those unbanked (i.e., households without savings or checking accounts), who would normally be precluded by mainstream financiers. Third, we integrate interest-free loans in our liquidity facility.[8] This is drawn from charitable teachings, specifically from Islamic religious tenets, that are proffered as a remedy to the prohibited interest (*ribā an-nasi'ah*).[9] Thus, it unveils the economic potential of this antiquated financing, conceived from cultural ideals, as a financial development device. Additionally, it challenges the widely-held view of interest as the primary credit allocation mechanism. Fourth, by binding eligibility to the liquidity facility with a member's fulfilment of the periodical contributions ruling, it harnesses the commitment technology sacrosanct with endogenous leveraged circuit-based institutions. This effectively moderates the issue of time-inconsistent preferences closely associated with payday loan borrowers.

The remaining of this paper is structured as follows. Section II details the landscape of the payday lending industry and related literature. Section III discusses the rationale for the prohibition of interest and its contrast against charitable modes in Islamic tenets. In Section IV, we develop a simple model to illustrate the Pareto-efficiency of endogenous interest-free payday loan circuit in addressing financial autarky of unbanked and underbanked households and its results. Finally, we conclude in Section V.

II. Landscape of payday industry and related literature

Payday lending emerged in early 1990s in response to increased demand for short term credit following the spatial void created by withdrawal of mainstream banks from small loans, low profit margin business segment (Flannery and Samolyk, 2005; Smith et al., 2008; OFT, 2010). The convenience of fast disbursement, minimal or non-existent credit checks further adds to its attractiveness (Caskey, 2005). An indicator of its growth pace is the

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[8] Here, we are drawn to the statement by the well-known Islamic scholar Fazlur Rahman (1964), who compartmentalises this form of funding to only philanthropic endeavours. The probable reason behind this limited worldview is because the Islamic jurisprudence (*fiqh*) literature is silent on the structuring of interest-free loan (*qard hasan*) for assisting the underprivileged. Such shortcomings in the development of *fiqh* provide ammunition to critique Islamic law (see Kuran, 2011).

[9] Unsurprisingly, charitable concept of interest-free funding is also present in other Abrahamic faith. For example, the existence of Jewish free loan societies is linked to the obligation in Judaism for extending free loans to the poor (Lewinson, 1999).

extensiveness of payday loan network across the United States. Payday lenders have more branch presence then McDonalds and Starbucks combined (Zinman, 2010). Based on the 2009 FDIC survey, approximately four million unbanked and underbanked households have frequented payday lenders, which is now a $38.5 billion industry (FDIC, 2009; CFSA, 2011).[10]

Unlike those served by micro-financiers, payday loan customers are relatively economically better off, for they must be employed and banked to subscribe to these services. They also differ from pawn broking customers due to their contrastingly higher income bracket (Johnson and Johnson, 1998), where majority of the borrowers enjoy moderate earnings of $25,000 to $50,000. Subscribers are mostly young, below the age of 45, single parent households, with middle level education (Elliehausen and Lawrence, 2001).[11] This category fits the profile of having lesser degree of financial sophistication presented in consumer finance theories.

The survey by Ellihausen and Lawrence (2001) finds majority are infrequent users of the payday lending facility. However, there are a selected few, accounting for 23% of total customers that have 14 or more loans in the same year.[12] These frequent users tend to roll over the outstanding loan. Generally, these loans would run for 2 weeks or less, or over a 3-4 week periods. These chronic borrowers are more likely to have exposure to more than one payday loan, exhibiting the classic case of borrowing from Peter to pay Paul, where a loan drawn on a new payday lender is often used to offset against an old one. Payday loan customers do subscribe to other means of credit, such as, bank and retail credit cards, and auto loans. However, most have maximised their credit limits on these sources of finance. Payday loan is attractive to its customers for the convenience and fast disbursement. Unlike mainstream financiers, credit checks are minimal.

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[10] In the United Kingdom, it is estimated a total of 1.2 million adults have taken out payday loans, amounting to £1.2 billion advances in 2009, and this is expected to rise further in the coming years. The United Kingdom payday lending industry is highly concentrated. One of the seven major players controls 25% of the 2009 total market share (Burton, 2010). However, this is expected to change with greater influx of payday lenders into the market, particularly from the United States (Goff and O'Connor, 2011).

[11] The United Kingdom payday loan market is generally similar to the United States except for its customer base and loan tenures. The borrowers are from a younger set under the age of 35, single, without children and income of £25,000 per annum. The payday loan runs on monthly basis, averaging 1 – 2 months (Burton, 2010).

[12] This is similarly observed by Flannery and Samolyk (2005) in their sample of two leading payday lenders.

The primary complaints against payday lenders are the exorbitant finance charge. Fees for a $100 loan ranges from $15 to $30, with annual percentage rate (APR) of 20-300%. The extremely high cost in contrast to other near credit substitutes raises criticism from consumer advocates and public agencies.[13] According to industry players, the APR is resultant from the small loan size, given payday lenders' fixed overhead costs coupled with the high default rates. Industry players argue that the $15 charge is definitely lower than the $50 flat rate returned check fees or a $25 covered overdraft (overdraft protection) by depository institutions (Morgan et al., 2012).

Payday lending is a regulated industry. It is subjected to state and federal laws and some players also subscribe to industry standards of the Community Finance Services Association (CFSA); an industry self regulatory organisation (Elliehausen and Lawrence, 2001).[14] The United States recently established a new regulatory body, the Consumer Financial Protection Bureau in July 2011 to oversee matters related to consumer protection, including market conduct of payday loan industry. This independent body is part of the financial reforms outlined in the Dodd-Frank Wall Street Reform and Consumer Protection Act 2010.[15]

Studies on payday lending have primarily centred on two aspects; namely consumer credit behaviours and welfare effects of the availability or withdrawal of this credit. Skiba and Tobacman (2008) seek to rationalise the demand for payday loans despite its excessively high fees. They find that payday loan borrowers exhibit partially naive quasi hyperbolic discounting tendencies. In that, the borrowers demonstrate overly optimistic forecast of future outcomes in respect of their own time preference, or their probability of absorbing future shocks.

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[13] Bertrand and Morse (2011) in testing effects of information disclosure on correcting cognitive biases, provide the following contrasting APRs: (i) payday advance 443%, (ii) instalment car loans 18%, (iii) credit card 16%, and (iv) subprime mortgages 10%.

[14] The industry is subjected to: (i) the Truth in Lending Act at the federal level that governs disclosure requirements; (ii) Fair Debt Collection Act that regulates debt collection practices; and (iii) National Bank Act that essentially allows the payday lender to enter into rent-a-bank model, which is now defunct by virtue of the stricter FDIC regulation on national chartered banks. The CFSA provides industry the best practices that are essentially focused on consumer protection.

[15] The governing act for payday loan in the United Kingdom is the Consumer Credit Act 1974 and the industry is regulated by the Office of Fair Trading (OFT).

Agarwal et al. (2009) find that the sampled population choose payday loans despite having unused liquidity on their credit cards. This exemplifies existence of liquid debt puzzle, whereby individuals undervalue their financial options. This also highlights the individuals' lack of cognitive ability to discern costs across different financial products. Gathergood (2012) points persistent indebtedness to poor financial literacy and self-control problems. In such a case, individuals are more likely to succumb to impulsive consumption. The ease of credit provided by high-cost credit providers including payday loan, further exacerbates this tendency and heighten the likelihood of over-indebtedness. Campbell et al. (2010) warrant that any public policy decisions must adopt a balanced approach between designing '*behaviourally informed regulatory changes*' to correct consumers' behavioural tendencies, i.e., present-bias preferences and limited cognitive ability, with assessment on the economic implications to the payday loan industry. This is aligned with Gathergood (2012), who supports paternalistic approaches in regulations, i.e., preventing access to credit that pushes consumers to succumb to sub-optimal behaviour.

In regards to its welfare effects, the evidence is still debatable, "*Do payday lenders, on net, exacerbate or assuage customers' financial difficulties?*" (Caskey, 2010, p.38). Morse (2011) and Zinman (2010) to name a few, argue that accessibility to payday loan is welfare enhancing, which is in contrast to Melzer (2011) and Morgan et al. (2012).[16] Using the 1996 natural disaster in California as an event that has widespread economic effect on households, Morse (2011) finds that presence of payday lenders reduces emergency distress and serious criminal incidences. Zinman (2010) finds that restricting access creates deterioration in financial position of Oregon households as opposed to those domiciled in Washington, as the control state. Households in the restricted payday state experienced higher unemployment and reported an overall poor future financial outlook. The negative effect of the regulatory ban on payday loan is worsened by the lack of financial substitutes.

III. Islamic prohibition of interest and the contrast against charity

[16] Thirty three states permit payday lending with rules on payday loan terms including maximum fees, rollovers, loan size, licensing and examination requirements as well as collection procedures for past-due loans. Seventeen states totally prohibit offering of payday loans. Contrary to the United States, the United Kingdom refrains from adopting intrusive regulatory measures, such as stringent price controls or complete ban on the services. The OFT holds such controls as market disruptive (OFT, 2010).

Salleh et al. (2012) demonstrate that Islamic prohibition of interest in credit transactions (*ribā an-nasi'ah*) is attributed to the inclination for expropriation of wealth. This occurs if there is inequity in the financial contract, thereby resulting in two equilibrium cases. One, in the case of financial repression, where the real interest rate is negative, the lender's assets are expropriated. Two, in case of negative leverage, where the real interest rate is greater than the unleveraged expected return on the asset being financed, then the borrower's assets are expropriated. In the long-run, this creates imbalances or unsustainable equilibria. When a borrower defaults, this can create a domino effect, given the interconnectedness of credit markets. It effectively amplifies volatility within the financial system and thus precipitates financial fragility, as evidenced in the present crisis. In extreme cases of agency costs of debt accruing to high project and default risks, this can lead to autarky or financial exclusion, with adverse impact on the underprivileged. Their study demonstrates interest-based financial transactions are non-Pareto optimal or at best it is Pareto-neutral to a risk-free credit.

Instead, the *Qur'ān* (the Holy Book of Islam) contrasts interest (*ribā*) with that of charity (*sadaqah*). The former creates factions in society, whilst the latter cements social cohesiveness (Ibn Taymiyyah, 1951). Charity, as defined in the practice of Prophet Muhammad PBUH (*Sunnah*), is not only concerned with financial forms but also all types of good deeds (Sahih Bukhari Vol. 2, 24:144; Sahih Muslim Vol. 3, 12:2329 -2330).[17] "*Charities ...provided a source of support for institutions and interest groups independent of, and sometimes in opposition, to the state. Islamic charities have historically played an additional role in society, that of promoter of decentralized economic development. ...In this respect, they reflect the blending of religious and secular, the social and economic, that is the key characteristic of the Islamic idea*" (Bremer, 2004, p.7). Piety through charitable deeds inculcates a sense of brotherhood and advances social welfare. This is clearly demonstrated in the *Qur'ān* that censures the practice of creditors, who cumulate the amount due for every delay in settlement that leads to further financial hardship on the debtor. The *Qur'ān* calls for the creditor to grant respite to the borrower such that, if the creditor were to forfeit the amount owed, this reflects a higher order of virtuousness, and will be rightly rewarded (verse 2:280; Sunan Ibn Mâjah – translated al-Khattab, Vol. 3:2417-2420).

[17] Although Islam enjoins charitable deeds, it prohibits begging, for it is best to be actively employed to uplift one's economic status (Sahih Bukhari Vol. 2, 24:1470-1471; Sahih Muslim Vol. 3, 12:2396, 2400 and 2404).

Both the *Qur'ān* and *Sunnah* have specific references for assisting the underprivileged. The financial forms of charity can be broadly categorised into *zakāt* (social welfare funds), *waqf* (philanthropic foundations) coupled with *qard* (interest-free loan) or *salaf* (synonymous with interest-free loan). *Zakāt* forms one of the five pillars of Islam and is obligatory on one's wealth for the benefit of the recipients identified in the *Qur'ān* (verse 9:60). Of interest is the specific directive for financial resources to be allotted for the poor and needy. Although *waqf* (*awqāf*, plural) is not mentioned specifically in the *Qur'ān*, it plays an instrumental role in Islamic civilisation. The earliest records on the practice of *waqf* can be traced to the Ottoman Empire in the eight century (Cizacka, 2000). It is said that these philanthropic foundations were able to financially support the provision of social services in Muslim society at that time, and in turn helped to address economic disparity. Such practice involved the endowment of privately owned properties for charitable purposes in perpetuity. The revenue generated by the *waqf* is then utilised according to its objects.

Qard signifies the extension of loan to a borrower from one's property without expectation of gains, whereby the lender forfeits the use of his property during the loaned period. Such is its prominence that it is ranked higher than charity and even equated as a loan to God himself (verses 2:245; 5:12; 57:11 and 18; 64:17; 73:20).[18] This benevolent loan is also synonymous with *salaf* that connotes the extension of a loan, subject to repayment at a later time (Al-Zuhayli, 2003). From a *fiqh* (Islamic jurisprudence) perspective, jurists are divided on the rights of the lender on the terms of the loan. Two widely opposing views are that a lender has absolute rights to recall the loan at anytime, whilst others view that it is permissible for the lender to stipulate the loaned period and hence, both contracting parties should abide by it (see Al-Zuhayli, 2003 on the debate by the four major *Sunni* schools of thought). This ambiguity in the *Shari'ah* interpretation can cause adverse repercussions in current financial context that warrants property rights certainty.[19] Underdevelopment of the *fiqh* accompanied with inadequacies of the *zakāt* system is a barrier to realisation of its true potential (see Kuran, 2003; 2004; 2011). This warrants reinvigorating the *zakāt* implementing institution and instigating the development of *fiqh*, as discussed below.

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[18] Ali (2002) connotes *qard* to "*spending in the cause of God*" (footnote 710, p.245). A benevolent loan does not exempt the borrower from honouring the debt. The severity of non-repayment is highlighted in the *Sunnah* whereby even a martyr who is forgiven for every sin is still bound by his debt (Sahih Muslim Vol. 5, 33:4883-4884. See also Ibn Mâjah Vol. 3:2412-2413, 2431).

[19] Earliest record on employment of *qard* by Az-Zubair also does not allude to its form and activity in which it was deployed (Sahih Bukhari Vol. 4, 57:3129).

IV. Model development

This section details the mathematical design of an *efficient interest-free* short term payday loan facility (using *endogenous* leverage) to address the inter-temporal liquidity needs of unbanked and underbanked households. Our endogenous leveraged circuit is founded in the works of institutional economics (Commons, 1931), and builds from the technology of ROSCA (Besley et al., 1993; 1994; Gugerty, 2007), its associated hybrids; namely, ASCRA (Bouman, 1995), and the more contemporary mutual and financial cooperative (Emmons and Mueller, 1997; Ebrahim, 2009). Besides liquidity transformation, the circuit features akin to an Islamic insurance (*takāful*) or mutual scheme where members guarantee each other from unexpected damage, losses or misfortune (Bouman, 1995).

Furthermore, unlike other endogenous leverage groupings, liquidity constrained members of the circuit receive short term interest-free payday loans, which is repaid at their next payday date. Our model paper expounds the elements that need to be observed if an interest-free loan that is enjoined in Islam is to have a profound impact in any financial development schemes.[20] Here, we demonstrate that this endogenous interest-free payday loan circuit integrated with appropriate constraints that circumvent adverse selection and moral hazard, can be Pareto efficient or at least neutral to that of its competitor, i.e., mainstream financier.

The interest-free payday loan circuit is structured as follows. Individuals are required to become members by contributing monthly to a common pool of funds. In our model, members are risk neutral, and the demand for liquidity or payday loan is treated as exogenous. Members can only apply for the interest-free loan after qualifying a defined period of membership. This gestation period has a two-fold effect. First, it allows the circuit to identify and assist the member in realisation of her/his financial goals. Second, it allows build up of member equity cushion through the monthly contributions. This effectively binds the member to the circuit and addresses member time-inconsistent preferences. In addition to these two covenants, other mandatory rulings to address adverse selection and moral hazard issues (ie., default cost) include requirement for (i) direct deposit of member paycheque into

[20] Our model explores alternative platforms for deployment of interest-free financing and augments previous studies by (i) Darrat and Ebrahim (1999) who focus on open market operation instrument in a partial equilibrium framework of *qard*-based Malaysian Government Investment Certificates; and (ii) Ebrahim (2009) on structuring alternative solutions for long-term real estate financing.

the circuit; and (ii) existence of loan guarantor (see detailed explanation below). Furthermore, once a member borrows from the circuit, she/he is required to undergo financial planning program to enhance her/his financial literacy. This helps errant members to plan ahead, alleviate future liquidity crises and stay debt free.

We implicitly assume the existence of an information architecture, where property rights needed for the forthcoming paycheque to serve as collateral, accurate methods of verifying or evaluating members' income and bankruptcy procedures are well established (see Levine et al., 2000). Individuals joining the circuit, assumed to have limited asset qualifying collateral and void of other alternative credit solutions, would have to subscribe to current high cost payday loan. Each member receives an exogenous flow of income. These assumptions are representative of the stylised facts of payday loan borrowers' demographics (see Ellihausen and Lawrence, 2001; FDIC, 2009).

The institutional framework of our efficient interest-free endogenous leverage circuit (i.e., Model 1), including essential covenants, is discussed in Section IVa. This is followed by stepped extensions of this basic framework: (i) Model 2 in Section IVb incorporates elements of (non)borrowing members within a circuit with a definite terminal period; and (ii) Model 3 in Section IVc further relaxes the elements whereby there is random borrowing that in the long-run approaches a steady state. A stylised depiction of the various scenarios for each of the model is captured in Figure 1.

[Insert Figure 1 here]

IVa. Institutional framework of an interest-free short term financing circuit (Model 1 – Figure 2)

[Insert Figure 2 here]

IVa(1). <u>This framework embeds elements of ROSCA and ASCRA technology (see Besley et al., 1993; 1994; Bouman, 1995; and Gugerty, 2007). The basic structure in Model 1 below illustrates the case of self-insurance, where circuit members are savers and also liquidity constrained borrowers.</u>

(i) Seed funding for the circuit stems from charitable funds (e.g. *zakāt* and *sadaqah* funds) that assist in the circuit start up. Ideally for long-run stability, this charitable fund

should be institutionalised and performs the central role of providing liquidity relief to individual circuits that may suffer from unforeseen shocks. This is akin to the *Verband*, associative level of the German cooperative banking system (Biasin, 2010).

(ii) On joining the circuit, each member is required to make periodic monthly contributions '*C*' into a pooled fund, from time *i = -m* (at the point of membership) to *i = 1* (the circuit terminal date). Here, we adopt monthly contributions to maintain consistency with the members' income stream, i.e., paycheques are generally issued on monthly basis. By instituting periodic contribution, it (i) moderates information asymmetry and adverse selection, as it reveals the financial behaviour of the prospective borrower (Akerlof, 1970); (ii) assists in long-run accumulation of wealth that minimises exposures to exogenous income shocks; (iii) acts as an equity buffer that minimises the likelihood of the member to strategically default on her/his borrowing (Foote et al., 2008); and (iv) most importantly, it acts a commitment device that moderates self-control issues associated with payday loan borrowers (Gugerty, 2007; Skiba and Tobacman, 2008).

The accumulated periodic contribution, represented by '*S*', forms the capital base of this circuit and is used to meet short term financial needs of liquidity constrained members. This is given in Equation (1), where '*m*' denotes the month building up to the disbursement of the interest-free liquidity facility.

$$S = \sum_{i=-m}^{t} C = C(t + m + 1) \tag{1}$$

When $t = 1$ (as in Models 1 and 2), this culminates into

$$S = \sum_{i=-m}^{1} C = C(m + 2) \tag{1a}$$

(iii) After satisfying the minimum gestation period, liquidity constrained members qualify to draw '*Q*' interest-free short term financing from the circuit at time *i = 1-n*, where '*n*' is a fraction of a month (i.e., *n* < 1 month).[21] The interest-free facility resembles a bullet loan, where total repayment of principal '*Q*' is made at terminal time *i = 1*. The loan repayment is net off the accumulated contributions '*S*'.

$$(Q - S) \tag{2}$$

[21] This implies members face liquidity problems before their next paycheque.

(iv) To account for the opportunity cost of capital employed within the circuit, '*C*' and '*Q*' are discounted by 'γ'. That is, the monthly discount rate comprises of an imputed return '*r*', which is equivalent to the average cost of fund incurred in mainstream credit market.

$$\gamma = \frac{1}{(1+r)} < 1, \ \forall \, r > 0 \tag{3}$$

(v) We also incorporate transaction cost 'ζ' associated with administering the circuit, eg. managing of members' contributions and loan processing (Emmons and Mueller, 1997; Kontolaimou and Tsekouras, 2010), and default cost 'α' (Jaffee and Russell, 1976).[22, 23] The circuit efficiency is contingent on minimising transaction and default costs, as they can fritter away the circuit's gains or cause erosion to its capital base (Coase, 1937; Alchian, 1950; Hart and Moore, 1996). In the models, both outflows are moderated by presence of covenants discussed below.

In line with the circuit's objectives, the discounted contributions and interest-free loan after accounting for transaction and default costs, coupled with net loan payoff, given by Equation (4) should at least be equal or greater than zero.

$$\left[\sum_{i=-m}^{1} C(1-\zeta)(\gamma^{i})\right] - Q(1-\zeta)(\gamma^{1-n}) + \gamma[(1-\alpha)(Q-S)+\alpha S] \geq 0 \tag{4}$$

Substituting the value of '*S*' in Equation (1) into Equation (4) gives us:

$$C(1-\zeta)(\gamma^{-m})[1+\ldots+\gamma^{m+1}] - Q(1-\zeta)(\gamma^{1-n}) + \gamma[Q(1-\alpha)+C(m+2)(2\alpha-1)] \geq 0 \tag{4a}$$

The periodic contribution in Equation (4a) form a geometric series that can be further simplified as follows:

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22 The institutional structure of the circuit already minimises upfront transaction costs compared to current payday lenders, as it (i) benefits from non-profit motive management force, (ii) does not incur external funding costs, and (iii) is not bound to issue investment returns to its 'depositors'.

23 Intuitively, utility derived from an interest-free credit facility would be higher than subscribing to high cost current payday loans or face financial autarky from mainstream credit. Therefore in such situations, we foresee that the (non) pecuniary costs associated with default penalty should be significantly severe such that it impels repayment of the loan (see Skiba and Tobacman, 2008 for empirical evidence of the degree of reliance of these borrowers on payday loans for their liquidity needs).

$$C\left[\frac{(1-\zeta)(\gamma^{-m})(1-\gamma^{m+2})}{1-\gamma}+\gamma(m+2)(2\alpha-1)\right]\geq Q\left[(1-\zeta)(\gamma^{1-n})-\gamma(1-\alpha)\right] \tag{4b}$$

$$\Rightarrow Q\leq C\left[\frac{(1-\zeta)(\gamma^{-m})(1-\gamma^{m+2})}{1-\gamma}+\gamma(m+2)(2\alpha-1)\right]\left[\frac{1}{(1-\zeta)(\gamma^{1-n})-\gamma(1-\alpha)}\right] \tag{4c}$$

Potential maximum loan is,

$$Q_{\max 1}=C\left[\frac{(1-\zeta)(\gamma^{-m})(1-\gamma^{m+2})}{1-\gamma}+\gamma(m+2)(2\alpha-1)\right]\left[\frac{1}{(1-\zeta)(\gamma^{1-n})-\gamma(1-\alpha)}\right] \tag{4d}$$

IVa(2). To moderate the risk of adverse selection and moral hazard, it is imperative for the circuit to institute covenants as follows:

(i) *Income and loan constraint*: Each member is subjected to an after tax income test '*y*' to ascertain her/his capacity to meet her/his periodic contribution and loan obligation. This not only supports responsible lending (Carr and Kolluri, 2001; Morgan, 2007), but also moderates the adverse selection issues (Jaffee and Russell, 1976; Stiglitz and Weiss, 1981). The member's financial capacity is represented by a multiple '*b*' of her/his income and loan.

(ia) Income constraint 'b_1'

Here, the income constraint 'b_1' curtails the contribution '*C*', given as follows:

$$\frac{y}{C} \geq b_1, \text{ which can be rewritten } \Rightarrow C \leq \frac{y}{b_1} \tag{5}$$

$$\Rightarrow C_{\max} = \frac{y}{b_1} \tag{5a}$$

(ib) Loan constraint 'b_2'[24]

Here, the loan constraint 'b_2' curtails the loan amount '*Q*', given as follows:

$$\frac{y}{Q} \geq b_2, \text{ which can be rewritten } \Rightarrow Q \leq \frac{y}{b_2} \tag{6}$$

$$\text{Here, } Q_{Binding,\ t-n} = \min\left\{\frac{y}{b_2}, Q_{\max,\ t-n}\right\}, \text{ where } Q_{\max,\ t-n} = \min\left\{Q_{\max 1}, Q_{\max 2,\ t-n}\right\} \tag{6a}$$

$Q_{\max 1}$ is defined in Models 1 – 3 (sections IVa – IVc) respectively by Equations (4d), (7e) and (16d), while $Q_{\max 2,\ t-n}$ reflects the resource constraint of the circuit given by $Q_{\max 2,\ t-n} = C(1-\zeta)(t+m)$.

[24] The interest-free payday loan facility is strictly for managing inter-temporal liquidity shocks faced by its members. In tandem with this objective, '*Q*' should therefore be confined to a reasonable multiple of its members' monthly after tax income. This helps alleviate debt entrapment, discussed in Ellihausen and Lawrence (2001). Nonetheless, our model can still be adapted to reflect allowances for this restriction.

If transaction cost is low, i.e., $\frac{y}{b_2} < Q_{\max}$, then $Q_{Binding,\ t-n} = \frac{y}{b_2}$ (6b)

(ii) *Pre-commitment constraint*: Members are subjected to salary deduction to moderate time inconsistent preference tendencies (Liabson, 1997; Stephens, 2002; Gugerty, 2007; Skiba and Tobacman, 2008) and moral hazard. With this, it partially limits the member consumption options available in the future. This seamless transfer of member income to the circuit and subsequent settlement of the interest-free loan has a secondary effect of lowering transaction costs of the circuit.

(iii) *Collateral constraint*: Given the limited ability of unbanked and underbanked households to raise asset qualifying collateral, disbursement of the interest-free payday loan is then subjected to a reputable co-signer, who provides surety upon default by the member.[25] The co-signer, who has local information compared to the circuit, is in a preferred position to conduct ex-post monitoring and impose social sanctions.[26] This then, significantly reduces costly state verification issues (Ghatak, 1999), particularly in dealings with low net worth members. However, failure of the co-signer to act accordingly can have a detrimental effect on the circuit efficiency/ sustainability (see Guinnane, 1994 on demise of Irish credit union).

(iv) *Financial capability constraint*: Each member who borrows is required to undergo personal finance program (eg. money management, asset building and debt management) to enhance their financial capability (Agarwal et al., 2009; Gathergood, 2012). This non-pecuniary cost of borrowing is an interventionist measure that has its roots in behavioural finance, as it seeks to influence the cognitive psychology of payday borrowers with regards to their financial conduct (see Bernheim et al., 2001;

[25] The permissibility of surety is affirmed in the *Sunnah* and by jurists (Ibn Rushd, 1996; Ibn Mâjah Vol. 3, Chapter on guaranty, No.2405-2406).

[26] The collateral covenant permits the co-signer to be from or outside the circuit. Where the co-signer is also a member of the circuit, co-signing incentivises peer monitoring, in view that the sustainability of the circuit ultimately affects the interest of the consignor (Stiglitz, 1990).

Bernheim and Garrett, 2003 on the positive long-term behavioural effects of increased exposure to financial education).[27]

Proposition 1. For the circuit to be competitive, its net surplus must satisfy the efficiency condition given by Equation (4c)

Equation (4c) signifies three possible states of the circuit. First, when the circuit fulfils the equality sign, the circuit is at best Pareto-neutral to its competitors, namely mainstream financiers.[28] Second, if the inequality sign is satisfied, the circuit then is Pareto-superior to its competitors. The surplus capital signifies welfare improvement of an initially liquidity constrained group. Third, if Equation (4c) is unmet, then the circuit is Pareto-inferior with erosion in its capital base, and its continued sustainability is doubtful. Here, its sustainability is contingent on minimising transaction costs and defaults, as both erode the circuit's gains and ultimately its capital base. Therefore, the circuit administrators must institute controls, so that both costs are reduced significantly. This is achieved through various covenants, as highlighted in the paper.

IVb. Extension of the model with fraction of members 'λ' borrowing from the circuit (Model 2 – Figure 3)

[Insert Figure 3 here]

As in Model 1, members are required to contribute 'C' on monthly basis upon entry, at $i = -m$ to $i = 1$ period. The following similarly hold in Model 2: (i) the circuit has a defined period, i.e., until $i = 1$, after which it terminates; (ii) variables defined in Equations (1), (2), (3) and (4); (iii) transaction and default costs; and (iv) the four covenants (i.e., income, pre-commitment, collateral and financial capability). However, Model 2 specification differs from previous in that it conceives that the likelihood of liquidity strained members may occur at different circuit cycles. Therefore, at any one time, there are a proportion of borrowers signified by 'λ' that are supported by '$(1-\lambda)$' lenders. This clearly depicts the 'transformation service' provided by the circuit, whereby the temporary idle funds of a proportion of

[27] Other interventionist measures, which are pecuniary in nature, are to gradually: (i) decrease b_1, and (ii) increase b_2, thereby compelling erring borrowers to save and avoid debt entrapment. This can be extended in our model to incorporate real world practicalities.

[28] We can also deduce that the circuit is Pareto-superior to that of contemporary payday loan, in view of the latter's high cost of funds.

members (lenders or non-borrowers) are used to provide financing to others who suffer from exogenous inter-temporal income shocks. This improves on "*competitive market by providing better risk sharing among people who need to consume at different random times*" (Diamond and Dybvig, 1983, p.402).

As with the previous section, observance of '*C*' entitles a member to the right of drawing on the circuit funds if she/he faces liquidity squeeze. We find the technology of the circuit in Model 2 best resembles the practice of group insurance or Islamic insurance (*takāful*), where members agree to indemnify each other against a defined loss. Based on the concept of solidarity, members of the group contribute to a specified fund that entitles each person to protection on occurrence of the loss event. The commercial implementation of this concept of mutuality can be traced to the eight century, where sea merchants would initiate a pool to protect themselves against perils during their voyages (Alhabshi and Razak, 2011).[29] A characteristic that differentiates group/ mutual/ Islamic insurance from the mainstream is that, in the former, each member is the insurer and also insured, which means there is risk sharing between members rather than risk shifting.

Based on the above extension, total borrowings in the circuit are now signified by 'λQ'. At time $i = 1$, i.e., expiry of the circuit cycle: (i) borrowing members are required to settle the outstanding interest-free short term loan net of accumulated contributions '$\lambda(Q\text{-}S)$'; and (ii) proportion of non-borrowing members '$(1\text{-}\lambda)$' are then entitled to a payback of their accumulated contributions constituting '$(1\text{-}\lambda)S$'.[30] Equation (7) is a modification of Equation (4), as it incorporates the fraction of borrowing and non-borrowing members.

$$\left[\sum_{i=-m}^{1} C(1-\zeta)(\gamma^{i})\right] - \lambda Q(1-\zeta)(\gamma^{1-n}) + \gamma\left[\lambda(1-\alpha)(Q-S) + \lambda\alpha S - (1-\lambda)S\right] \geq 0 \qquad (7)$$

$$\Rightarrow \left[\sum_{i=-m}^{1} C(1-\zeta)(\gamma^{i})\right] - \lambda Q(1-\zeta)(\gamma^{1-n}) + \gamma\left[\lambda Q - \lambda\alpha Q + S(2\lambda\alpha - 1)\right] \geq 0 \qquad (7a)$$

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[29] Although there is no direct reference to *takāful* in Islamic scriptures, the concept finds support in the *Qur'ānic* verses and *Sunnah* that call for the removing of hardships, upholding of brotherhood and solidarity in the face of hardship (*Qur'ān* 5:2; Sahih Muslim Vol. 6, 45: 6585-6590, 45:6669-6674).

[30] In our model, a member's primary objective in joining the circuit is to ensure access to credit, in contrast to excessive credit pricing by payday lenders or financial autarky. Thus, we assume the only incentive is to maximise borrowing rather than generate dividends or returns on the accumulated contributions.

Substituting the value of '*S*' in Equation (1) into Equation (7a) gives us:

$$C(1-\zeta)(\gamma^{-m})[1+.....+\gamma^{m+1}]-\lambda Q(1-\zeta)(\gamma^{1-n})+\gamma[\lambda Q(1-\alpha)+C(m+2)(2\lambda\alpha-1)]\geq 0 \quad (7b)$$

This is further simplified as follows:

$$C\left[\frac{(1-\zeta)(\gamma^{-m})(1-\gamma^{m+2})}{1-\gamma}+\gamma(m+2)(2\lambda\alpha-1)\right]\geq \lambda Q[(1-\zeta)(\gamma^{1-n})-\gamma(1-\alpha)] \quad (7c)$$

$$\Rightarrow Q\leq C\left[\frac{(1-\zeta)(\gamma^{-m})(1-\gamma^{m+2})}{1-\gamma}+\gamma(m+2)(2\lambda\alpha-1)\right]\left[\frac{1}{\lambda(1-\zeta)(\gamma^{1-n})-\gamma(1-\alpha)}\right] \quad (7d)$$

Potential maximum loan is,

$$Q_{\max 1}=C\left[\frac{(1-\zeta)(\gamma^{-m})(1-\gamma^{m+2})}{1-\gamma}+\gamma(m+2)(2\lambda\alpha-1)\right]\left[\frac{1}{\lambda(1-\zeta)(\gamma^{1-n})-\gamma(1-\alpha)}\right] \quad (7e)$$

Proposition 2. The efficiency condition of the circuit with fraction of members who are (non) borrowers is contingent on satisfaction of Equation (7d)

The three efficiency states described earlier in Proposition 1 apply in Proposition 2. This is even with the added complexity, where not all members will borrow during the same circuit cycle. The circuit can ensure that it satisfies the inequality sign in Equation (7d) by enhancing its predictive ability on probability of liquidity calls by its members. This is closely associated with the principle law of large numbers employed in insurance pricing. By collating sufficiently large number of exposures, the randomness in the occurrence of the exposures will statistically converge towards a defined mean with a given variance, which then allows insurers to fairly predict the frequency and severity of their exposures and price the insurance products accordingly. In the case of the circuit, it can then correctly determine the loan amount and tenure that is feasible to limit liquidity gaps at the end of the circuit cycle.

IVc. Extended model incorporating random multi-period borrowing (Model 3 – Figure 4)

[Insert Figure 4 here]

We further extend the model to allow for multi-period endogenous leverage, where members pool their endowments across time, in order to assure accessibility to short-term interest-free loan, in light of unexpected contingencies. This brings the circuit nearer to that of contemporary financial cooperatives (Emmons and Mueller, 1997; Ebrahim, 2009). Here, we have a random process of member borrowing. This discrete-parameter Markov chain of $\{X_{t-n}, t>n\}$ is represented by:

$$P(X_{t+1-n} = j / X_{1-n} = i_1, X_{2-n} = i_2, ..., X_{t-n} = i_t) = P(X_{t+1-n} = j / X_{t-n} = i_t) \quad (8)$$

Equation (8) essentially assumes a member's future borrowing behaviour is a consideration of only her/his present behaviour, and is independent of the member's past history. The initial probability vector 'p_{t-n}' is denoted by probability of borrowing 'λ_{t-n}' and non-borrowing '1-λ_{t-n}', respectively:

$$p_{t-n} = \begin{bmatrix} \lambda_{t-n} & 1-\lambda_{t-n} \end{bmatrix} \quad (9)$$

We also assume during the next interval that there is a probability 'ρ_{t+1-n}' that members borrow and '1-ρ_{t+1-n}' otherwise. The two-state Markov chain transition probability matrix is illustrated below.

$$P = \begin{array}{c} \\ Borrow_{t-n} \\ NoBorrow_{t-n} \end{array} \begin{array}{c} \begin{array}{cc} Borrow_{t+1-n} & NoBorrow_{t+1-n} \end{array} \\ \begin{bmatrix} \rho_{t+1-n} & 1-\rho_{t+1-n} \\ \phi_{t+1-n} & 1-\phi_{t+1-n} \end{bmatrix} \end{array} \quad (10)$$

The above two-state transition matrix converges in steady state as follows (see Hsu, 2011).

$$P = \begin{bmatrix} \rho & 1-\rho \\ \phi & 1-\phi \end{bmatrix} \quad (10a)$$

This matrix in Equation (11a) is further simplified using the well-known Bayes' rule, as illustrated in the Appendix, where we realise $\phi = \frac{\lambda(1-\rho)}{1-\lambda}$, and $1-\phi = \frac{1-2\lambda+\rho\lambda}{1-\lambda}$.

$$\begin{array}{cc} Borrow_{t+1-n} & NoBorrow_{t+1-n} \end{array}$$

$$\Rightarrow P = \begin{matrix} \\ Borrow_{t-n} \\ NoBorrow_{t-n} \end{matrix} \begin{bmatrix} \rho & 1-\rho \\ \dfrac{\lambda(1-\rho)}{1-\lambda} & \dfrac{1-2\lambda+\rho\lambda}{1-\lambda} \end{bmatrix} \tag{10b}$$

The long-run borrowing behaviour converges to a steady state ' $\hat{\rho}$ '. That is, there exists a stationary distribution for the Markov chain. This is found by solving

$$\hat{p}\begin{bmatrix} \rho & 1-\rho \\ \dfrac{\lambda(1-\rho)}{1-\lambda} & \dfrac{1-2\lambda+\rho\lambda}{1-\lambda} \end{bmatrix} = \hat{p} \tag{11}$$

Where, $\hat{p} = \begin{bmatrix} s_1 & s_2 \end{bmatrix}$, and $s_1 + s_2 = 1$ (12)

Equation (11) can then be rewritten as follows:

$$\begin{bmatrix} s_1 & s_2 \end{bmatrix}\begin{bmatrix} \rho & 1-\rho \\ \dfrac{\lambda(1-\rho)}{1-\lambda} & \dfrac{1-2\lambda+\rho\lambda}{1-\lambda} \end{bmatrix} = \begin{bmatrix} s_1 & s_2 \end{bmatrix} \tag{13}$$

Solving the matrix, we obtain two equations described below:

Equation 1

$$s_1\rho + s_2\frac{\lambda(1-\rho)}{1-\lambda} = s_1 \tag{14}$$

$$\Rightarrow s_1 = s_2\left(\frac{\lambda}{1-\lambda}\right), \text{ for } \rho \neq 1 \tag{14a}$$

Equation 2

$$s_1(1-\rho) + s_2\left(\frac{1-2\lambda+\rho\lambda}{1-\lambda}\right) = s_2 \tag{15}$$

$$\Rightarrow s_1 = s_2\left(\frac{\lambda}{1-\lambda}\right), \ \forall \rho \neq 1 \tag{15a}$$

Thus, both Equations (14a) and (15a) lead to the same solution, implying the exogeneity of 'ρ'. By substituting 's_1' in Equation (14a) from Equation (12), we get

$$1 - s_2 = s_2\left(\frac{\lambda}{1-\lambda}\right) \tag{15c}$$

$$\Rightarrow 1 = s_2\left(\frac{1}{1-\lambda}\right)$$

$$\Rightarrow s_2 = 1-\lambda \text{, and hence } \Rightarrow s_1 = \lambda \tag{15d}$$

Thus, restating '$\hat{\rho}$' of Equation (11) with the results derived in Equation (15d) gives us the steady state matrix as follows:

$$\hat{\rho} = \begin{bmatrix} \lambda & 1-\lambda \end{bmatrix} \tag{15e}$$

Proposition 3. A member borrowing behaviour is contingent on her/his past borrowing history.

We find member borrowing behaviour is path dependent, which corroborates the empirical evidence documented in Elliehausen and Lawrence (2001). Despite this intricate issue of path dependency, we can still determine the loans to be underwritten by exploiting the property of steady state, where a fraction 'λ' of the population borrow (irrespective of previous borrowing). For mathematical tractability, we assume that: (i) borrowers who do not redeem their loans, continuously rollover their facility; and (ii) a fraction 'α' of the loans 'Q' is written off as default at the terminal period T (see Figure 1). This is aligned with Elliehausen and Lawrence (2001), whereby a fraction of the borrowing pool exhibits tendency of rolling over their loans. As such, default will emerge only at the termination of the program. This is illustrated in Equation (16) (given below). All other variables and covenants remain the same.

$$\left[\sum_{i=-m}^{T} C(1-\zeta)(\gamma^i)\right] - \left[\sum_{i=t-n}^{T-n} \lambda Q(1-\zeta)(\gamma^i)\right] + \left[\sum_{i=t+1-n}^{T-1} \lambda Q\gamma^i\right] + \gamma^T\left[\lambda Q(1-\alpha) + S(2\lambda\alpha - 1)\right] \geq 0 \tag{16}$$

We substitute the value of ' S ' from Equation (1) into Equation (16) and simplifying it to derive

$$C(1-\zeta)(\gamma^{-m})\left[1+\ldots+\gamma^{T+m}\right]-\lambda Q(1-\zeta)(\gamma^{t-n})\left[1+\ldots+\gamma^{T-t}\right]+\lambda Q\left(\gamma^{t+1-n}\right)\left[1+\ldots+\gamma^{T-t-2+n}\right]$$
$$+\gamma^{T}\left[\lambda Q(1-\alpha)+\lambda C(T+m+1)(2\lambda\alpha-1)\right]\geq 0 \quad (16a)$$

$$\Rightarrow C(1-\zeta)(\gamma^{-m})\left(\frac{1-\gamma^{T+m+1}}{1-\gamma}\right)-\lambda Q(1-\zeta)(\gamma^{t-n})\left(\frac{1-\gamma^{T-t+1}}{1-\gamma}\right)+\lambda Q\left(\gamma^{t+1-n}\right)\left(\frac{1-\gamma^{T-t-1+n}}{1-\gamma}\right)$$
$$+\gamma^{T}\left[\lambda Q(1-\alpha)+\lambda C(T+m+1)(2\lambda\alpha-1)\right]\geq 0 \quad (16b)$$

$$\Rightarrow Q\leq C\left[\left(\frac{(1-\zeta)(\gamma^{-m})(1-\gamma^{T+m+1})}{1-\gamma}\right)+\gamma^{T}\lambda(T+m+1)(2\lambda\alpha-1)\right]\text{X}$$
$$\left[\left(\frac{1-\gamma}{\lambda\left[(1-\zeta)(\gamma^{t-n})(1-\gamma^{T-t+1})-(\gamma^{t+1-n})(1-\gamma^{T-t-1+n})\right]}\right)-\left(\frac{1}{\gamma^{T}\lambda(1-\alpha)}\right)\right] \quad (16c)$$

Potential maximum loan is,

$$Q_{\max 1}=C\left[\left(\frac{(1-\zeta)(\gamma^{-m})(1-\gamma^{T+m+1})}{1-\gamma}\right)+\gamma^{T}\lambda(T+m+1)(2\lambda\alpha-1)\right]\text{X}$$
$$\left[\left(\frac{1-\gamma}{\lambda\left[(1-\zeta)(\gamma^{t-n})(1-\gamma^{T-t+1})-(\gamma^{t+1-n})(1-\gamma^{T-t-1+n})\right]}\right)-\left(\frac{1}{\gamma^{T}\lambda(1-\alpha)}\right)\right] \quad (16d)$$

Proposition 4. The efficiency condition of a circuit with multi-period borrowing by a fraction of members is contingent on satisfaction of Equation (16c)

The efficiency states detailed in Proposition 1 similarly applies for Proposition 4. We find that a circuit's efficiency can be improved in a multi-period model. A circuit that is conducted repeatedly over a series of periods will have greater latitude on its borrowing policy, as each borrower's financial conduct is fully revealed (Hosios and Peters, 1989). By instituting renewal model that is dependent on the member's financial conduct, the circuit effectively addresses conflict of interest between borrowers and non-borrowers. In this situation, each member will endeavour to undertake fewer risks, which would potentially affect access to future liquidity facility. Credible threat of sanctions in multi-period states can also reduce moral hazard (Stiglitz and Weiss, 1983).

IVc(1). Numerical illustration

Using Equations (4d), (7e) and (16d), we conduct a mathematical simulation to enumerate the breakeven level of the loan advanced in each of the three models. The circuit exogenous factors encompass: (i) member income profile y; (ii) cost of fund prevailing in mainstream credit market r; (iii) transaction and default costs ζ and α; (iv) loan tenure and drawdown period n and t; (v) underwriting constraint corresponding to the income multiple b_1 and b_2; (vi) gestation period prior to loan drawdown m; (vii) fraction of borrowing members λ; and (viii) substantive circuit life T. We use the observations by Ellihausen and Lawrence (2001), the FDIC (2010) and Hawkins (2011) to check the reasonableness of the exogenous parameters. Overall, the final values of the exogenous parameters are set to avoid excessive financial burden and ensure a liberal round of liquidity cycle, until member reaches financial security.

[Insert Table 1 here]

We tabulate the efficiency scenarios, given various permutations of the endogenous parameters, which cover (i) maximum member monthly contribution: C_{max}; (ii) maximum accumulated savings: S_{max}; and (iii) potential maximum loan: Q_{max}. Table 1 illustrates the effect on the endogenous factors, given changes in the exogenous parameters. This provides an indicative pricing framework that can be emulated in the design of similar endogenous circuits. It highlights the sensitivity of each endogenous factor to the decisions that the circuit undertakes and the various levers that may be combined to enhance the circuit efficiency.

Additionally, Table 2 provides the resultant values of the endogenous parameters, which assure that the circuit satisfies the Pareto-efficiency propositions under Models 1 - 3. Model 3 further demonstrates the interplay of the loan constraint covenant between $\frac{y}{b_2}$ or Q_{max}, where Q_{max} is characterised by the lower of either Q_{max1} or $Q_{max2,\ t\text{-}n}$. Here, $Q_{Binding}$ demands balancing the twin issues of: (i) protecting the member from potential debt entrapment; and (ii) ensuring the circuit's long-run liquidity, i.e. solvency. By not pursuing aggressive loan disbursement policies, it promotes accumulation of equity buffer that would ultimately allow the circuit greater financial latitude to pursue financial policies that enhance

member welfare within the reasonable risk tolerance limits, eg. relaxing the '$Q_{Binding}$' constraint and undertaking loan rehabilitation program that customises the loan repayment tenure for genuinely financially constrained member.

[Insert Table 2 here]

Based on Equation (16d), we extend the simulation to illustrate the effect of transaction cost on the potential loan amount, while holding other exogenous factors constant (see Figure 4).[31] Premised on the loan covenant in Equation (6) with loan multiple of $b_2 = 10$ and monthly after tax income of $y = \$2{,}000$, $\frac{y}{b_2}$ is then fixed at \$200. On the other hand, 'Q_{max}' changes with variation in the transaction cost 'ζ', i.e., there exists an inverse relationship between 'Q_{max}' and 'ζ'. '$Q_{Binding}$' as given in Equation (6a) is the minimum of either $\frac{y}{b_2}$ or Q_{max}. As highlighted in Equation (6b), if the transaction cost is low, i.e., $\frac{y}{b_2} < Q_{Max}$, then $Q_{Binding} = \frac{y}{b_2}$. Otherwise, $Q_{Binding}$ is restrained by Q_{max}. The critical transaction load, whereby $\frac{y}{b_2} = Q_{max}$, is when $\zeta = 28.7\%$, which is signified in Figure 4 by $\zeta_{critical}$.

[Insert Figure 5 here]

V. Discussion and conclusion

Payday borrowers are categorically those who suffer from poor credit history, exhibit time-inconsistent preferences and are often precluded by mainstream financiers. This financial exclusion and poor financial tendencies expose them to potential predation by payday lenders who offer short term, small and unsecured financing at usurious rates. Given payday borrowers' already precarious financial standing, the repressive terms (i.e., high cost lending and predatory motives) could lead to a vicious cycle of debt entrapment if the borrower fails to observe the repayment term. Despite the unfavourable publicity against payday loans industry, financially constrained households still succumb to its services. This

[31] Exogenous factors are: y = \$2,000, m = 6 months, r = 15%, α = 10%, λ = 0.4, T = 180 months, and t = 1.

underlines a latent need for inexpensive short term financial facility to bridge their liquidity needs.

Unlike previous studies on payday loans, this study undertakes to conceptualise a solution to usurious payday loans and address financial autarky in mainstream credit. It entails the design of an institutional structure that embeds the interplay of cultural beliefs and cost efficient organisations. Our model is based on risk-neutral economic agents within an endogenous leverage circuit that draws from the technology of member based institutions such as ROSCA and its hybrids, i.e., ASCRA, mutual and financial cooperative. A unique feature of this structure is that it harnesses the concept of coalition of savers and borrowers to allay inter-temporal liquidity shocks faced by its members, through the deployment of interest-free payday loan.

Our study illustrates the employment of this antiquated charitable form in contemporary financial perspective. This credit modality is chosen for its contrast with current payday loans. Furthermore, it is held esteemed in religious tenets, which specifically distinguish such deeds from usurious practices. We demonstrate that the circuit performs favourably in contrast to current usurious payday loans. First, the interest-free facility averts expropriation of wealth, an issue associated with payday loans. The periodic contribution, which features a minimal fraction of members' salary, promotes asset building which should consequently improve their financial security in the long-run. Second, our member based endogenous circuit attenuates the issue of financial exclusion. It allows credit accessibility to households disfavoured by financial institutions. This financial reach extends not only to those underbanked but even unbanked households that would typically be excluded from mainstream credit markets. Third, we attest the economic proposition of interest-free loans expounded in religious teachings in current financial settings, whereby the circuit is able to boot strap its resources to grow endogenously. Fourth, in line with documented studies of time-inconsistent preferences of these households, the institutional design of our interest-free payday loan relies on the commitment technologies advocated with circuit-based structures.

The efficiency of an endogenous leveraged circuit is contingent on observing risk control measures to constraint adverse selection and moral hazard issues, thus reducing default and transaction cost significantly. This builds on ensuring equitable commitment, i.e., the periodic contribution can be fulfilled without jeopardising financial interests of individual

members and the circuit. This is followed through by requiring the commitment to be directly dispensed into the circuit, which would effectively pre-empt irrational consumption tendencies. This is fortified with programs that build the members' financial capability and route them from poor credit tendencies. Next, we require existence of co-signer that acts in absence of standard collateral. Here, the co-signer's central role is in reducing costly state verification and execution of credible sanctions. The institutional design of the circuit provides upfront dilution of transaction costs that directly feeds into promoting the circuit efficiency.

Given the circuit technology that is member driven, accumulation of substantive capital base may create lag in time to loan issuance. To manage the gestation period, the circuit may rely on seed funding from *zakāt* and *sadaqah* to reinforce its initial capital base. These charitable funds can also be institutionalised to provide safety net to the circuit that defrays any long-run sustainability issues. Alternatively, the interest-free loan facility can be integrated into an already operational circuit. Results from our study supports the policy direction outlined in the FDIC (2007) small-dollar loan program. That is, it adopts affordable pricing, observes risk-based underwriting, maximises technology and automation, integrates savings component in combination with financial education. Last, our model sets an indicative pricing mechanism, mostly absent in charitable institutions, which in the long-run promotes self-sufficiency.

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Appendix

A. Proof

We employ conditional probability premised on Bayes' rule with notations B: Borrow and NB: No Borrow, respectively to derive at:

(i) $$P\left(NB_{t+1-n} / NB_{t-n}\right) = \frac{P\left(NB_{t+1-n} \cap NB_{t-n}\right)}{P\left(NB_{t-n}\right)}$$

$$= \frac{P\left[NB_{t+1-n} \cap \left(\cup - B_{t-n}\right)\right]}{P\left(NB_{t-n}\right)}, \text{ where } \cup \text{ is the universal set}$$

$$= \frac{P\left[NB_{t+1-n} \cap \cup\right] - P\left[NB_{t+1-n} \cap B_{t-n}\right]}{P\left(NB_{t-n}\right)}$$

$$= \frac{P\left[NB_{t+1-n}\right] - P\left[NB_{t+1-n} \cap B_{t-n}\right]}{P\left(NB_{t-n}\right)}$$

$$= \frac{\left(1-\lambda_{t+1-n}\right) - \left(1-\rho_{t+1-n}\right)\lambda_{t-n}}{1-\lambda_{t-n}}$$

Subsequent reiterations yield the following in steady state:

$$= \frac{\left(1-\lambda\right) - \left(1-\rho\right)\lambda}{1-\lambda}$$

$$= \frac{1-2\lambda+\rho\lambda}{1-\lambda}$$

(ii) $$P\left(B_{t+1-n} / NB_{t-n}\right) = 1 - P\left(NB_{t+1-n} / NB_{t-n}\right)$$

Subsequent reiterations yield the following in the steady state:

$$= 1 - \left[\frac{1-2\lambda+\rho\lambda}{1-\lambda}\right]$$

$$= \frac{1-\lambda-\left(1-2\lambda+\rho\lambda\right)}{1-\lambda}$$

$$= \frac{\lambda\left(1-\rho\right)}{1-\lambda}$$

B. Figures

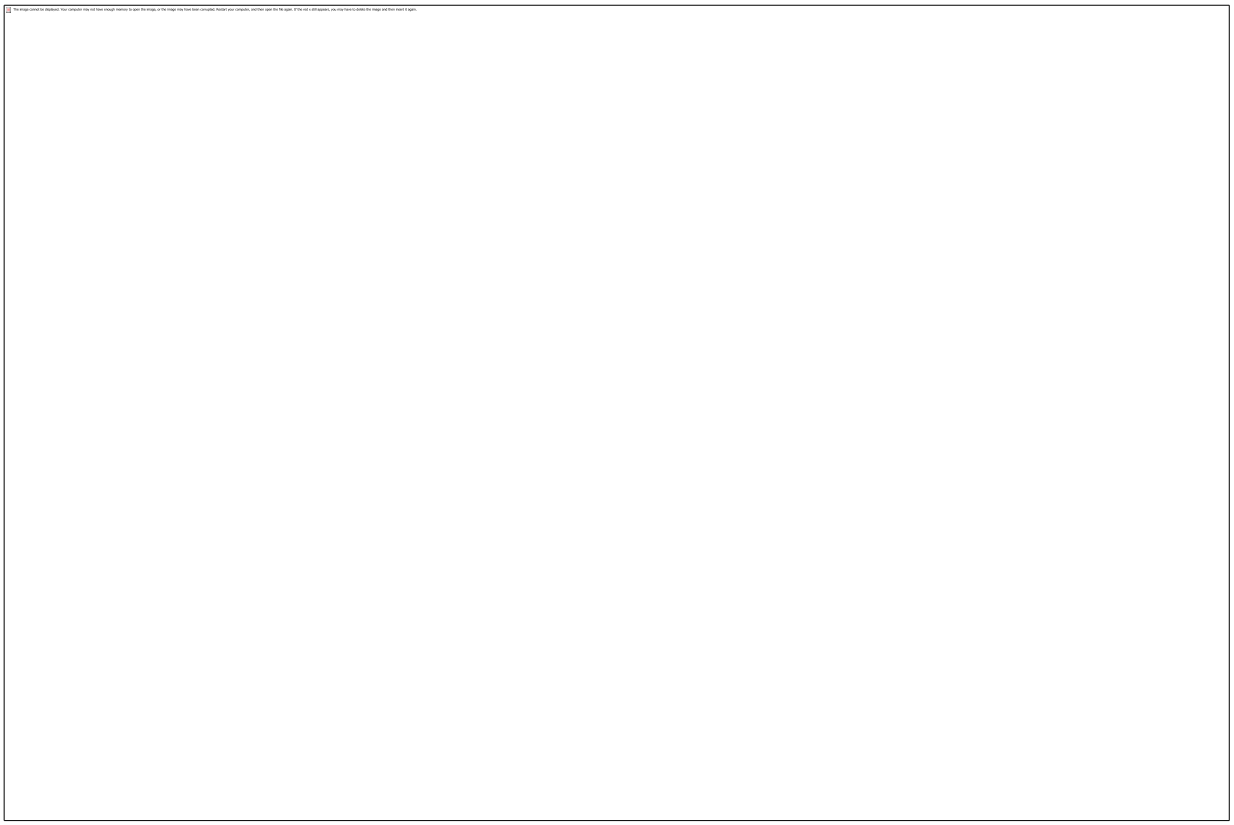

Figure 1. Members financial conduct with default outcomes under each model.

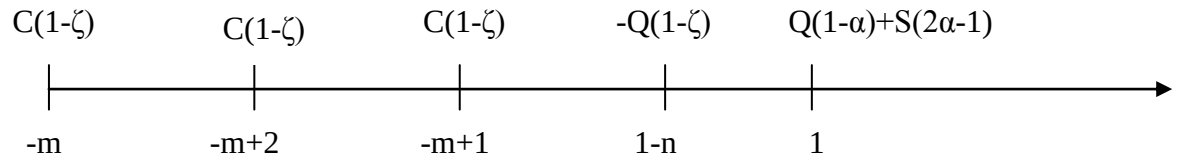

Figure 2. All members are savers and also liquidity constrained borrowers.

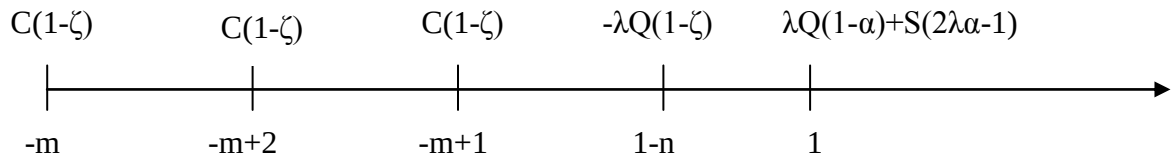

Figure 3. A fraction of liquidity constrained members borrow from the circuit 'λ' and supported by '1-λ' non-borrowing members.

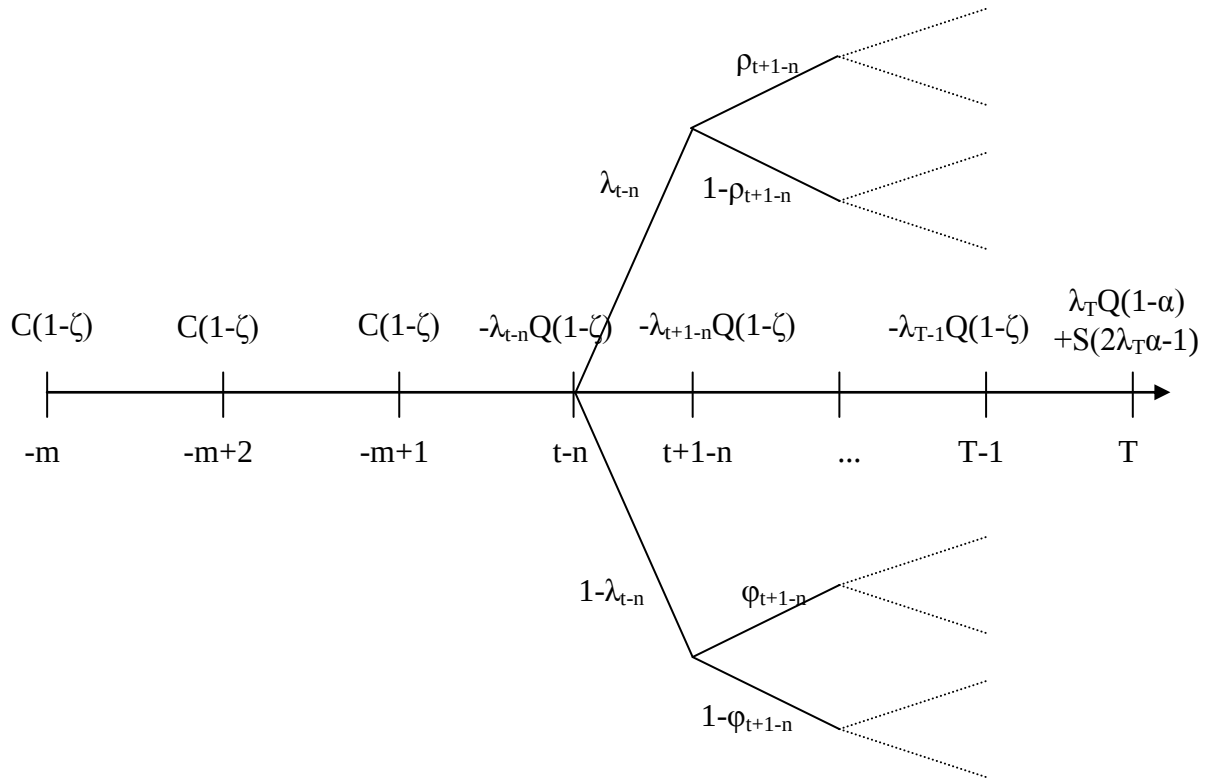

Figure 4. A fraction of liquidity constrained members borrow from the circuit 'λ' across multi-periods and this reaches a steady state.

Figure 5. Effect of transaction cost on the circuit potential maximum loan.

C. Tables

Table 1. Indicative pricing structure of the endogenous interest-free payday loan circuit

Increase in exogenous factor	Direction of change in endogenous factor		
	C_{max}	S_{max}	Q_{max}
y	+	+	+
b_1	+	+	+
b_2	uc	uc	+
r	uc	uc	+
ζ	uc	uc	–
α	–	–	–
m	+	+	+
n	uc	uc	–
λ	uc	uc	–
T	uc	uc	+

Notes: Direction of change in the endogenous values '+' increase; '–'decrease, and 'uc' unchanged.

Table 2. Results illustrating circuit Pareto-efficiency for each model

Model 1										
b_1	b_2	r	ζ	α	m	n	C_{max}	S_{max}	Q_{max1}	$Q_{Binding}$
100	10	12%	2%	10%	6	¼ ⅓	20	160	1,045 960	200
		15%	2%	10%	6	¼ ⅓	20	160	1,228 1,113	200
50	10	12%	2%	10%	6	¼ ⅓	40	320	2,091 1,921	200
		15%	2%	10%	6	¼ ⅓	40	320	2,456 2,226	200

Model 2											
b_1	b_2	r	ζ	α	m	n	λ	C_{max}	S_{max}	Q_{max1}	$Q_{Binding}$
100	10	12%	2%	10%	6	¼	0.2 0.3 0.4	20	160	4,044 2,794 2,170	200
						⅓	0.2 0.3 0.4	20	160	3,715 2,567 1,993	200
		15%	2%	10%	6	¼	0.2 0.3 0.4	20	160	5,026 3,444 2,652	200
						⅓	0.2 0.3 0.4	20	160	4,555 3,121 2,404	200
50	10	12%	2%	10%	6	¼	0.2 0.3 0.4	40	320	8,087 5,589 4,339	200
						⅓	0.2 0.3 0.4	40	320	7,430 5,135 3,987	200
		15%	2%	10%	6	¼	0.2 0.3 0.4	40	320	10,052 6,887 5,305	200
						⅓	0.2 0.3 0.4	40	320	9,109 6,241 4,807	200

Model 3													
b_1	b_2	r	ζ	α	m	n	λ	T	C_{max}	S_{max}	Q_{max1}	Q_{max2}	$Q_{Binding}$
100	10	12%	2%	10%	6	¼	0.2	180	20	3,740	2,417	137	137
							0.3				1,611		
							0.4				1,208		
						⅓	0.2	180	20	3,740	2,394	137	137
							0.3				1,596		
							0.4				1,197		
						¼	0.2	240	20	4,940	2,417	137	137
							0.3				1,611		
							0.4				1,208		
						⅓	0.2	240	20	4,940	2,394	137	137
							0.3				1,596		
							0.4				1,197		
		15%	2%	10%	6	¼	0.2	180	20	3,740	2,279	137	137
							0.3				1,520		
							0.4				1,140		
						⅓	0.2	180	20	3,740	2,253	137	137
							0.3				1,502		
							0.4				1,127		
						¼	0.2	240	20	4,940	2,279	137	137
							0.3				1,520		
							0.4				1,140		
						⅓	0.2	240	20	4,940	2,253	137	137
							0.3				1,502		
							0.4				1,127		
50	10	12%	2%	10%	6	¼	0.2	180	40	7,480	4,833	274	200
							0.3				3,222		
							0.4				2,417		
						⅓	0.2	180	40	7,480	4,788	274	200
							0.3				3,192		
							0.4				2,394		
						¼	0.2	240	40	9,880	4,833	274	200
							0.3				3,222		
							0.4				2,417		
						⅓	0.2	240	40	9,880	4,788	274	200
							0.3				3,192		
							0.4				2,394		
		15%	2%	10%	6	¼	0.2	180	40	7,480	4,559	274	200
							0.3				3,039		
							0.4				2,279		
						⅓	0.2	180	40	7,480	4,506	274	200
							0.3				3,004		
							0.4				2,253		
						¼	0.2	240	40	9,880	4,559	274	200
							0.3				3,039		
							0.4				2,279		
						⅓	0.2	240	40	9,880	4,506	274	200
							0.3				3,004		
							0.4				2,253		

Notes: The model is solved for endogenous variables C_{max}, S_{max} and Q_{max} where C_{max} is the maximum monthly contribution, S_{max} is the maximum savings accumulated from the contributions, and Q_{max} is the potential maximum loan per period. Total loan advanced is given by $Q_{Binding} = min\ \{y/b_2, Q_{max}\}$. The values of the endogenous variables depicted in the table above signify the breakeven threshold that ensures the circuit is Pareto-neutral. For this simulation, the exogenous parameters are: (i) member monthly after tax income: y = \$2,000; (ii) income multiplier constraint: $b_{1,1}$ = 80 times, $b_{1,2}$ = 40 times; (iii) loan multiplier constraint: b_2 = 25 times; (iv) cost of funds: r_1 = 12%, r_2 = 15%; (v) transaction and default costs: ζ = 2% and α =10%; (vi) membership gestation period: m = 6 months; (vii) fraction of borrowers in the circuit: λ_1 = 0.2, λ_2 = 0.3; λ_3 = 0.4; (viii) loan tenure: n_1 = 7 days (¼ month); n_2 = 10 days (⅓ month); (ix) loan commencement period: t = 1; and (x) circuit life: T_1 = 15 years (180 months), T_2 = 20 years (240 months).

Glossary of Arabic terms

Arabic term	Closest English meaning
fiqh	Islamic jurisprudence.
hiba	Voluntary gift.
ijtihād	Literally 'exertion'. It implies independent deduction of laws not self-evident from the primary sources, namely the *Qur'ān* and *Sunnah*.
qard	The act of extending interest-free loan from one's property without expectations of gains. It is also known as *qard hasan* or *qardah-yi hasanah*.
Qur'ān	The holy book of Islam.
ribā	An injunction protecting property rights. This is generally misinterpreted as usury *or* interest.
ribā an-nasi'ah	This is termed as evident *ribā*. It is generally an injunction to deter expropriation of assets on deferred exchanges. It also mitigates financial fragility and the exclusion of underprivileged from financial services.
sadaqah	Voluntary offering or alms from a person's wealth.
salaf	The granting of loan subjected to repayment at a later time.
shari'ah	Islamic law
sunnah	The practices of the Prophet Muhammad PBUH. Along with the *Qur'ān* and *Hadith* (recorded sayings of the Prophet Muhammad), it is a major source of *Shari'ah*, or Islamic law.
takāful	Islamic insurance that functions similar to mutuals.
waqf (awqāf – plural)	Philanthropic foundations involving the endowment of privately owned properties for charitable purposes in perpetuity.
zakāt	Literally 'cleansing or purity'. It implies a religious tax to be deducted from one's wealth to help the needy.