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RUNS, TRANSPARENCY AND REGULATION: ON THE OPTIMAL DESIGN OF STABLECOIN FRAMEWORKS

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ABSTRACT

Stablecoin issuers can become subject to runs just like banks. This is because, in the absence of adequate regulation, issuers are incentivised to hold disproportionate amounts of high–yielding but illiquid assets in their reserve portfolios. The value of such reserve assets may be overly volatile, thus inducing investors to suddenly redeem their stablecoins. To mitigate the risk of runs, recent regulatory initiatives propose that reserve–asset portfolios should be overcollateralized, and that stablecoin issuers provide sufficient disclosure to holders about their composition. We show how transparency incentivises stablecoin issuers to keep a larger share of the reserves in liquid assets, thus reducing the risk of runs and potential bankruptcy ex–ante. In addition, transparency on reserves disincentivises stablecoin holders from irrationally demanding the reimbursement of their funds. We calculate the social welfare under different equilibria and analyse how regulatory interventions, like suspension of redemptions, may affect the welfare outcomes.

KEYWORDS

Stablecoins, Runs, Transparency, Regulatory Policy

JEL CODES

G23, G28, I30

1. Introduction

Stablecoins are crypto assets promising a one–to–one conversion of the coins to an underlying asset, typically a fiat currency. The holders of stablecoins should thus be able to redeem their investment at any point in time against the currency of denomination. Stablecoins represent a liability on the balance sheet of the issuer. This liability is matched by a portfolio of reserve assets that should ensure the stability of the peg and that redemptions can be promptly met upon the holders' demand. To some extent, the system can resemble a fixed currency regime or a currency board arrangement but, unlike such public institutions, stablecoin issuers lack a clear policy instrument. Unlike government–led currency peg arrangements, stablecoin issuers also respond to private profit–maximising incentives.

Anderson and Papadia (2020) highlight that in the presence of asymmetric information about the composition of the reserve asset portfolios, stablecoin issuers can be subject to runs, just like banks. This is because, in the absence of sufficient regulation and transparency requirements, profit–maximising issuers are incentivised to hold disproportionate amounts of high–yielding but illiquid assets in their reserve portfolios. Such assets might become difficult to sell in situations of large–scale redemptions and/or generally challenging liquidity conditions. Like any other asset, they are also exposed to shocks and fluctuations in value that could further impair the reimbursement capacity of the issuer.

To mitigate the risk of runs, Anderson and Papadia (2020) propose that issuers should (i) hold assets in excess of liabilities (i.e. equity – we use this term interchangeably with "overcollateralization of assets") to compensate for potential devaluations of the reserve–assets portfolio, and (ii) adopt adequate transparency standards about the size and composition of this portfolio[1]. The role of transparency is key because of its effects on both the issuers and the holders of stablecoins. On the one hand, knowing that stablecoin holders have access to the information concerning the composition of reserves should incentivise issuers to keep a larger share of reserves in liquid assets, thus reducing the risk of runs and potential bankruptcy ex–ante. Importantly, as showed by Ahmed et al. (2024), an ex–post approach could provide different results. For instance, if increased transparency reveals information about weaker–than–predicted capitalisation of the issuer, a run could be triggered as investors' perception of the issuer's soundness would be jeopardised. Therefore, from a modelling point of view, the ex–post approach to regulatory interventions envisions an effect on an already–established scenario. With an ex–ante perspective, instead, these interventions determine the state of the issuer which is then assumed to stay static.

In this paper we adopt the ex–ante approach to propose a simple model of runs on stablecoins that highlights the mitigating effect of transparency. We formalise the result from Anderson and Papadia (2020) and EBA (2024), accounting for the role of overcollateralization and potential shocks

[1] In a recent regulatory proposal for asset referenced tokens, the EBA calls for both overcollateralization of reserve portfolios and transparency on the reserve assets. See EBA (2024) for details.

on asset prices. Recent work has addressed this issue from different perspectives (Bertsch, 2023; Ahmed et al., 2024). We provide a simple framework where we analyse social welfare outcomes of the potential equilibria, and then analyse the effects of regulatory interventions in the form of suspensions (Matta and Perotti, 2023). In an empirical application we put our model into a real–life balance sheet of an anonymous stablecoin issuer, to analyse the composition of the asset side and to determine the amount of liquid assets it should optimally hold.

2. Literature Review

Stablecoins have recently emerged on policymakers' agendas due to their growing popularity among the operators in the crypto ecosystems. Arner et al. (2020) suggest that this could be mostly due to the promise of stablecoins to keep a stable peg with a traditional fiat currency, which may appear attractive given the strong fluctuations in value of other kinds of cryptocurrencies such as Bitcoin. Yet, as highlighted by the same authors, stablecoins can be exposed to fluctuations in value of their reserve assets that could jeopardise the attainment of their peg and result in runs. In turn, as put forth by Gorton et al. (2022), this could translate into negative repercussions on the real economy.

Special attention has therefore been paid on regulatory concerns (Bains et al., 2022). As suggested by Anderson and Papadia (2020), Bertsch (2023) and Ahmed et al. (2024), the two main elements that act as mitigants to the inherent fragilities of stablecoins are transparency and capital requirements. The role of capital requirements is straightforward: the more equity stablecoin issuers hold, the larger the buffer against potential devaluations of their assets. The role of transparency is more subtle and depends on the perspective of the analysis. From an ex–post point of view more transparency can also become detrimental: for instance, if an issuer was not well capitalised relative to expectations, and this information were disclosed, transparency itself might trigger a run. From an ex–ante point of view, instead, being subject to stringent transparency requirements should incentivise the issuer to hold a sufficiently large share of liquid assets and equity to face potential shocks.

Recent work has covered both possibilities: Bertsch (2023) adopts the ex–ante approach to analyse both the scale of adoption of stablecoins and the exposure to runs, endogenizing the liability side of the issuer. He finds that adoption is likely to be excessive, given that the marginal adopter does not internalise the drawbacks associated with composition and network effects. Introducing transparency and capital requirements can then minimise risk taking. Ahmed et al. (2024) adopt the ex–post approach, and study the conditions of stablecoin runs in a more general global game setting where the proneness to runs depends not only on transparency but also on the volatility of the reserve assets and on the stablecoin holders' prior beliefs about the quality of the reserve assets. This gives rise to an outcome with multiple equilibria and leads to a conclusion that transparency may either increase or reduce run risk, depending on the combinations of reserve asset volatility and investors' prior information. In this paper, we stress that both approaches can lead to multiple equilibria.

3. Model Setup

The core of our model builds on the classical framework by Diamond and Dybvig (1983). We consider a three–period economy with $D > 0$ consumers and $E > 0$ investors. In period 0, each consumer and investor is endowed with 1€. In the same period, investors form a monopolistic stablecoin issuer funded by the money they are endowed with. The equity of the issuer thus amounts to *E*€. The issuer is managed by the same investors, so the two terms will be used interchangeably. Each consumer purchases a 1€–worth of stablecoins. For convenience, we assume they yield no interest. Therefore, the liabilities of the issuer amount to *D*€.

The total amount of funds collected by the issuer in period 0 is *D*€ + *E*€, which are invested in a share s of liquid assets and $1 - s$ of illiquid assets (we assume that total assets correspond to total reserves), for instance, bonds. At the end of period 1, investors receive a return $r_l > 0$ from liquid assets and a return $r_L > r_l$ from illiquid assets, after an asset price shock $v > 0$ is realised and consumers wishing to redeem their coin in period 1 have made their redemption request. If still active, at the end of period 2 the stablecoin issuer is liquidated. The link between yield and liquidity has been established, at least for bonds, by a conspicuous strand of the literature (see e.g. Acharya and Pedersen, 2005; Bao et al., 2011; and Acharya et al., 2013). We refer to these contributions to support our argument that investors require higher yield to compensate for illiquidity of their investments (Friewald et al., 2012).

Consumers are of two types, a and b. Type–a agents only value consumption in period 1, and cannot consume in period 2. Type–b agents prefer consuming in period 2, but have the possibility to do so in period 1 if needed. A fraction $0 < \vartheta < 1$ of consumers is of type a, $1 - \vartheta$ of type b. Consumers choose their consumption path after the issuer has set the composition s of the reserve portfolio and the shock v is realised. To do so, consumers of either type can redeem their coins from the issuer and use the funds to acquire one unit of the economy's only good. To face these redemptions, the issuer is only able to sell liquid assets. If in period 1 the issuer has not enough liquid assets to face the redemptions, consumers will run, and will be serviced on a first–come–first–served basis. Furthermore, we assume that the issuer will have to declare bankruptcy in period 1 if the realised shock exceeds the amount of the issuer's equity, or redemption requests exceed the remaining amount of liquid funds, and no suspension is imposed.

In period 2, the only funds available to consumers are those stemming from the liquidation of the issuer's assets, provided that it did not declare bankruptcy in period 1. Consumers do not directly observe s, but at the beginning of the first period they receive an information signal about it which is proportional to the degree of transparency the issuer is subject to. Neither the issuer nor the consumers observe the distribution of consumers between the two types until s is set, but they can observe the other variables. For simplicity, we assume no intertemporal discounting.

4. Investors

Investors are profit–driven, and thus they are incentivised to hold high–yielding but illiquid assets into the reserve portfolio. At the same time, they realise that holding an excessively low amount of reserves in liquid assets could expose them to runs and bankruptcy. Given the negative correlation between liquidity and yield, we translate these preferences into the following simple objective function:

$$U^{inv} = \tau s - \frac{s^2}{2}. \tag{1}$$

This is concave with respect to the share of liquid assets held. The parameter $0 \le \tau \le 1$ is an indicator of transparency. This can be interpreted as a given level of disclosure on the composition of reserve assets that must be shared with stablecoin holders by law or by regulation. The larger τ, the stricter transparency requirements, and the more precise information about the composition of reserve the consumers receive.

The first term of equation (1) captures the "preventive incentive" of the issuer to keep more liquid assets to maximise its probability to meet redemptions. This term is proportional to τ: the issuer anticipates that if disclosure requirements are strict, holders may know the amount of liquid assets held and run if they deem it insufficient[2]. The second term captures the "profit incentive" of the issuer, which incentivises them to invest in illiquid assets with higher returns.

These characteristics are captured by the fact that the function U^{inv} is concave in s. Maximising U^{inv} with respect to s gives:

$$s = \tau. \tag{2}$$

For similar reasons than just outlined, it is straightforward that the issuer optimally sets its share of liquid assets proportionally to the transparency requirement. In turn, this implies that the regulator may want to demand a high degree of disclosure so as to reinforce the preventive incentive of the issuer.

[2] In their more general setup, Ahmed et al. (2024) showed that this is particularly the case whenever the reserve assets are volatile and/or consumers have low priors about the quality of the reserve assets.

5. Consumers

The utility functions of a type–a and type–b consumer are respectively given by:

$$U^a = \mathrm{u}(c_1^a), \quad (3)$$
$$U^b = \mathrm{u}(c_1^b) + \rho \mathrm{u}(c_2^b), \quad (4)$$

with u ≥ 0, u(0) = 0, u' > 0 and u'' < 0. c_t^i is the consumption of a type–i consumer in period t. The parameter $\rho > 1$ characterises type–b agents' relative preference for consumption in period 2. Agents decide when to consume in period 1, after observing the realisation of v and receiving the signal about the share of liquid assets set by the issuer. We assume this is equal to the degree of transparency of the issuer, τ.

Determining the first–best allocation of consumption for each type of agent is now trivial: given their preferences, each type–a agent would consume his euro in period 1, whereas each type–b agent would consume nothing in period 1 and spend his euro only in period 2, after receiving the funds from the liquidation. We assume no partial consumption. Therefore, the shock v can affect the number of consumers able to redeem their funds, but not how much each of them would consume, which is always 1 unit. This allocation corresponds to:

$$U^a = \mathrm{u}(1), \quad (5)$$
$$U^b = \mathrm{u}(0) + \rho \mathrm{u}(1) = \rho \mathrm{u}(1). \quad (6)$$

The sum of utilities for all consumers, which we define as social welfare, is thus given by $\vartheta D\mathrm{u}(1) + (1 - \vartheta)D\rho\mathrm{u}(1)$. This first–best allocation is only feasible provided that the following holds:

$$\vartheta D \leq s(D + E - v), \quad \text{(C1)}$$
$$D + E - v - \vartheta D \geq (1 - \vartheta)D \leftrightarrow E \geq v. \quad \text{(C2)}$$

The first condition (C1) implies that the issuer is able to meet the redemptions of type–a agents in period 1. The second condition (C2) ensures that the funds that remain available in period 2 suffice to cover the redemptions of all type–b agents and that the issuer is not bankrupt.

6. Runs, Illiquidity and Bankruptcy

The sequence of events in period 1 can be summarised in three steps: first, the issuer sets s. Then, type–b consumers receive the information signal about it and observe the shock v. Finally, they decide whether to run or not. If in the second step the shock erases all of the issuer's equity, the issuer will go bankrupt. It follows that a run in the following step will not be possible as bankruptcy has already occurred. On the other hand, if the shock is minor, a run would *not* be triggered as long as, in the last step, type–*b* consumers observed:

$$\vartheta D \leq \tau(D + E - v). \tag{C3}$$

The parameter $0 \leq \tau \leq 1$ is the information signal about s that type–*b* consumers receive before deciding their consumption path. C3 thus implies that these consumers *think* the issuer is able to meet the redemptions of type–*a* agents in period 1. From (2), we know that in equilibrium this signal corresponds to s. Thus, C1 and C3 are equivalent in equilibrium.

If either of the two is not verified, both type–*a* and type–*b* consumers will try to redeem their funds in period 1 (before investors receive their returns), resulting in a run. Type–*b* consumers would (rightly) assume that the issuer does not hold sufficient amounts of liquid assets to meet all the type–*a* redemptions, thus deciding to run. In this case, the issuer becomes illiquid. That is: it is not able to meet the redemptions requests from *all* consumers with its liquid assets available. This condition corresponds to:

$$D > s(D + E - v), \tag{C4}$$

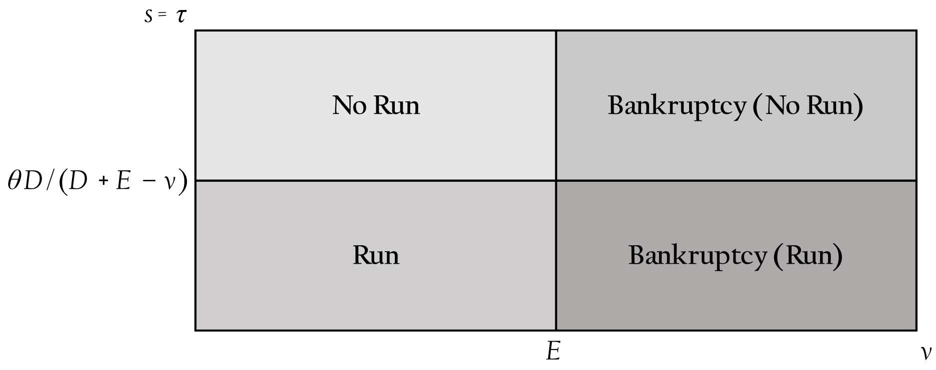
and in equilibrium it necessarily stems from C3 (or C1). In other words, if a run takes place, the issuer will necessarily be illiquid. At this point, it might either go bankrupt, or undergo a suspension imposed by the government. This latter hypothesis is analysed in section 9.

7. Equilibria

Our model setup gives rise to multiple equilibria. Specifically, depending on the parameter values, four types of equilibria can be identified: (i) a no run equilibrium with no bankruptcy of the issuer; (ii) a run equilibrium where the issuer is illiquid, and bankruptcy thus depends on whether a suspension is imposed or not; (iii) an equilibrium where the issuer goes bankrupt due to the shock v erasing equity, but where a run would have *not* taken place; and (iv) an equilibrium where the issuer goes bankrupt due to the shock v erasing equity, and where a run would have taken place.

The selection of the equilibrium will be determined by the conditions C3 (C1) and C2. If condition C3 is verified a run will not take place. Otherwise, it will occur. If C2 is not verified, the issuer goes bankrupt before type–*b* consumers could decide whether to run (for C3 not verified) or not (for C3 verified). These scenarios are summarised in figure 1 (note that the threshold level for $s = \tau$ on the y axis is obtained from C3, or equivalently from C1).

Figure 1: Possible Equilibria



No Run

This case corresponds to the upper–left case of figure 1. Here, conditions C2 and C3 (and thus also C1) hold: the degree of transparency is high, inducing the issuer to invest the stablecoin reserves in a sufficiently large proportion of liquid assets. The asset price shock is small relative to the amount of equity held by the issuer. Type–*a* agents consume in period 1, while type–*b* agents consume in period 2. All consumers are serviced: this case thus corresponds to the first–best outcome for both types. Type–*a* agents obtain $U^a = \mathrm{u}(1)$, whereas type–*b* agents obtain $U^b = \mathrm{u}(0) + \rho\mathrm{u}(1) = \rho\mathrm{u}(1)$. Therefore, social welfare is given by $\vartheta D\mathrm{u}(1) + (1 - \vartheta)D\rho\mathrm{u}(1)$.

Bankruptcy (No Run)

Even if condition C3 is verified, the issuer might still go bankrupt if the realised shock were large enough to erase the issuer's total equity, invalidating C2. This corresponds to the upper–right case of figure 1. Given that illiquid assets cannot be sold in period 1, only $s(D + E - v)$ consumers can be serviced. The resulting utility of consumers who get serviced is $U^a = U^b = \mathrm{u}(1)$. Those who are not serviced get $U^a = U^b = 0$. Social welfare amounts to $s(D + E - v)\mathrm{u}(1)$.

Run

If in equilibrium condition C3 is not verified, then the issuer does not hold enough liquid assets to cover all the redemptions. Given the information signal they receive, type–*b* agents will run and the issuer will become illiquid. In the absence of further interventions (see next section), the issuer faces bankruptcy. This corresponds to the bottom–left case of figure 1. If the issuer is allowed to go bankrupt, given that only liquid assets can be sold in period 1, only $s(D + E - v)$ consumers can be serviced and obtain $U^a = U^b = \mathrm{u}(1)$. The rest of the consumers obtain $U^a = U^b = 0$. Social welfare is now given by $s(D + E - v)\mathrm{u}(1)$, which is the same expression as in the previous case. Yet, it is important to note that this value is higher than before, since now $E > v$ (C2 is verified). In other words, given the small size of the shock v, more liquid assets can be distributed and thus more consumers served.

Bankruptcy (Run)

In this scenario (bottom–right case of figure 1), the issuer goes bankrupt due to the large shock it faces. It would have otherwise faced a run as C3 is not verified. Social welfare and its distribution are identical to the case of the bankruptcy equilibrium with no implicit run.

Overall, a clear ranking of equilibria in terms of social welfare emerges: the no–run equilibrium without issuer's bankruptcy provides the first–best outcome. The run equilibrium with issuer's bankruptcy ranks second best. The worst outcome is the one where the issuer goes bankrupt given a large asset price shock, since the value of assets that can be sold, and the number of consumers that can be serviced, is the lowest (see previous paragraphs). This is regardless of whether there would be an implicit run or not, as in either case the run is not realised. Finally, from figure 1 it is easy to see that a higher amount of equity makes the conditions for the first–best outcome (no–run equilibrium without issuer's bankruptcy) easier to satisfy: a larger E both lowers the threshold on the y axis and pushes the threshold on the x axis to the right.

8. A Numerical Example

Using publicly available data from a major stablecoin issuer, we construct a simplified balance sheet that provides some real–world numbers to verify the classification of the different equilibria. To ensure anonymity, we have first averaged the data along the last five observations over time, and then normalised it relative to the amount of total assets, which we fix at 100. This simplified balance sheet appears as follows:

Figure 2: Simplified Balance Sheet

	Assets	Liabilities
Liquid	50.5	49.42
Illiquid	49.5	Equity
		50.58
Total	100	100

We assume that the share of type–*a* consumers is $\vartheta = 0.5$, the propensity of type–*b* agents to consume in period 2 is $\rho = 1.5$, and the asset price shock $v = 30$. In terms of the degree of transparency, measured on the vertical axis of figure 1, this gives the "run threshold" as max 35%. The equity threshold to avoid bankruptcy due to the asset price shock (on the horizontal axis of figure 1) is min 50.58. In our chosen balance sheet presentation, the share of liquid assets held by the issuer is 50.5%. This is above the 35% threshold, implying that the issuer in this case is not exposed to the run risk. For the size of the asset price shock selected, the issuer also does not go bankrupt (as 30 < 50.58). Therefore, this scenario provides the first–best outcome, which is the no–

run equilibrium without issuer's bankruptcy: Social welfare is given as 0.5(49.42) + 0.5(49.42)(1.5) = 74.13.

As an alternative scenario, we increase the asset price shock to v = 50.59 while keeping all the other parameters as before. This produces a new run threshold at max 50%, which is higher but still below the share of liquid assets held by the issuer (50.5%). However, the asset price shock is now larger than the issuer's equity and, therefore the equilibrium with issuer's bankruptcy without an implicit run materialises. Social welfare is now given by 0.505(100 – 50.59) = 24.95. This outcome would also apply in case of bankruptcy without an implicit run. Finally, we set ϑ = 0.8 and, as in the first case, v = 30 < 50.58. This moves the run threshold further up to max 56%, which is now above the share of liquid assets held by the issuer. This combination of values produces a run equilibrium. Assuming the issuer is left to go bankrupt, social welfare is now 0.505(100 – 30) = 35.35.

9. Regulatory Interventions

Three elements should be highlighted from our analysis thus far: first, the more liquid assets and equity the issuer holds, the more likely an equilibrium without a run; second, the larger the asset price shock, the more likely an equilibrium with bankruptcy. Liquid assets and equity thus serve as a mitigating factor to reinforce the resilience of the issuer vis–à–vis the expectations of the consumers and the volatility of the reserve–assets portfolio. Third, transparency emerges as a key determinant of the optimal share of liquid assets the issuer should hold in its reserve portfolio. A corresponding regulatory requirement steers the outcome away from the run equilibria.

Yet, runs are still possible and entail suboptimal welfare results: regulators may intervene ex post to mitigate this phenomenon. Besides transparency requirements, the regulator may impose a suspension of withdrawals to stop a run[3]. We turn to analyse this case. We assume this suspension can take place in period 1, once the regulator has observed the share of liquid assets set by the issuer, the price shock, as well as the share of one agent's type in the economy. The regulator's objective is to maximise social welfare. The issuer's balance sheet is such that C3 does not hold (a run takes place). To avoid the issuer's bankruptcy, the regulator imposes a suspension.

Following the suspension, the regulator then manages the assets until maturity (as in any case, illiquid assets cannot be sold in period 1). Assets can be thought of as bonds with different maturities: we assume that liquid bonds mature in period 1, while illiquid bonds mature in period 2. We further assume the regulator cannot store funds from period 1 to period 2 (i.e. they must be redistributed right after collection), and that assets do not yield interest.

[3] Of course, these are just *some* of the interventions that could be envisioned, and specifically to stop a run. Further interventions may include for instance, the application of capital requirements as for banks.

The suspension is applied if the issuer is illiquid but not bankrupt. Thus, $E > v$. By letting assets mature, the regulator thus collects $D + E – v$. The regulator will be able to repay all consumers by redistributing liquid assets in period 1 and illiquid assets in period 2 upon maturity. To maximise consumers' utility, the regulator will only redistribute the proceedings to type–*a* agents in period 1, which receive U^a = u(1), and only to type–*b* agents in period 2. These latter receive $U^b = \rho$u(1). Social welfare is ϑDu(1) + $(1 – \vartheta)D\rho$u(1). The first–best allocation is thus achieved.

10. Conclusion

Stablecoin issuers are exposed to sources of instability that, similarly to the traditional banking system, could result in runs and bankruptcy. Firstly, the fact that stablecoin holders, like depositors in a bank, may redeem their coins at an unanticipated point in time implies that the issuer may easily become illiquid if a run occurs and a sufficiently high proportion of its reserve assets is not invested in liquid instruments. Secondly, bankruptcy may result from either a run or an exogenous shock affecting the value of the reserve assets portfolio. While overcollateralization can mitigate such risks, the probability of bankruptcy cannot be fully eliminated if the reserve assets are subject to negative shocks. In other words, our results suggest that multiple equilibria are possible even from an ex–ante approach.

This simple model also embraces the claim from Anderson and Papadia (2020) according to which transparency can play an important role in mitigating the fragilities of stablecoin issuers. Specifically, a higher degree of transparency about the composition of the reserve–assets portfolio can provide consumers with clearer information, induce the issuer to hold more liquid assets ex–ante, and make runs less likely. Our results also suggest that regulatory interventions after a run has become imminent, in the form of a suspension, can still reduce the negative impact of potential bankruptcy on consumers, and that letting assets mature after imposing the suspension can deliver the first–best social welfare outcome. Overall, our simple model builds the case for close monitoring by supervisory authorities, overcollateralization, and tight disclosure rules.

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