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Pricing liquidity support: a PLB for Switzerland

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Abstract
The proposed revision of the Swiss Banking Act introduces a public liquidity backstop (PLB) for distressed systemically important banks (SIBs), in part to facilitate resolution. We examine the impact of the PLB on fiscal balances, welfare, and the incentives of bank shareholders and management. A PLB, like too-big-to-fail (TBTF) status, acts as a subsidy for non-convertible bonds, which can create negative externalities. Corrective measures should be implemented before the PLB is activated to align incentives with societal interests. We conservatively estimate that UBS Group's TBTF status results in funding cost reductions of at least USD 2.9 billion in 2022. The risk for Switzerland of hosting SIBs warrants additional precautionary savings.

Keywords Liquidity, Public liquidity backstop, Too-big-to-fail, Banks

1 Introduction

The failure of a systemically important bank (SIB) can trigger severe financial and economic disruptions, imposing significant costs on society. To mitigate this risk—without resorting to bank nationalization or relying on a takeover by a rival—policymakers worldwide have worked to enhance the resilience and resolvability of SIBs, in particular within the framework of the Basel Accords and the initiatives of the Financial Stability Board.

Since effective bank resolution typically requires central bank liquidity support, these efforts have also included measures to ensure access to sufficient liquidity during times of crisis. Specifically, several countries have developed legal frameworks that allow for the use of Public Liquidity Backstops (PLBs) as a policy tool during banking crises. A PLB facilitates access to central bank liquidity for a distressed SIB by providing a guarantee from the national treasury. The primary goal of a PLB is to support the bank's restructuring process and prevent its complete collapse, thereby mitigating the risk of broader systemic disruption.

In 2022, the Swiss Federal Council decided to introduce a framework for implementing a PLB in Switzerland, and it instructed the Federal Department of Finance to develop a proposal by mid-year 2023. However, in March 2023, using emergency legislation, the Federal Council enacted measures, including the introduction of a PLB, aimed at preventing the uncontrolled collapse of Credit

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Suisse.[1] Later, in September 2023, the Federal Council adopted a Dispatch on introduction of a PLB for SIBs.[2] The bill has not yet been adopted and has faced delays in parliament (committee suspension until end of 2026).

This note examines the rationale for a Swiss PLB and its remuneration by banks. Section 2 provides a brief overview of the Federal Council's proposal. Section 3 discusses the effects of a PLB and its fee structure on fiscal balances, bank shareholders and management, and society at large. We draw several conclusions.

High leverage, limited liability, and externalities can distort the decisions of SIB shareholders and managers. These distortions impose broader societal costs and heighten the risk of government intervention, potentially increasing public debt, taxation, and inflation. Governments are likely to intervene in crisis periods, regardless of legal frameworks and fiscal consequences; securing fiscal soundness may therefore require ex ante compensation.

Liquidity support and other too-big-to-fail (TBTF) measures subsidize non-convertible bond financing, benefiting shareholders and encouraging excessive leverage and risk-taking. Liquidity support backed by a PLB interacts with other components of TBTF subsidies. Regulation should comprehensively address the TBTF subsidy through proactive measures such as taxes, capital restrictions, or other tools, regardless of a bank's current performance.

Finally, the existence of SIBs introduces systemic risk, necessitating additional precautionary savings, which should be factored into the broader societal cost–benefit analysis of maintaining such institutions.

Against that background, Sect. 4 reports estimates in the literature of the value of implicit TBTF subsidies and presents a new one. Our estimate is derived from the Merton (1974) and Finkelstein et al. (2002) models, both of which are widely used in risk assessment. Erring on the side of caution by systematically making conservative assumptions that should lead us to under- rather than overestimate TBTF subsidies, we find subsidy rates that are orders of magnitude larger than the proposed ex ante PLB fee. Our most conservative estimate suggests a subsidy rate on senior debt of approximately 1.6%, resulting in a total TBTF funding advantage of at least USD 2.9bn for UBS Group AG alone in 2022, which compares with net profits of USD 7.2bn.

Section 5 concludes.

[1] See, for example, Böni et al. (2023) and Coelho et al. (2023).

[2] See https://www.newsd.admin.ch/newsd/message/attachments/82424.pdf for the Dispatch (in German) and https://www.admin.ch/gov/en/start/documentation/media-releases.msg-id-97631.html for a brief summary.

2 The Swiss PLB proposal

The September 2023 Dispatch adopted by the Federal Council proposes to change the Swiss Banking Act.[3] The Dispatch envisions the PLB as a third line of defense in ensuring the orderly resolution of SIBs. The first line of defense requires SIBs to meet their liquidity needs through their own liquid assets and market sources, with additional liquidity buffers mandated under the TBTF requirements. The second line involves the provision of extraordinary liquidity loans from the SNB, available only against suitable collateral. In cases where these measures are inadequate, the PLB would offer a third line of defense, providing liquidity support through loans with a government-backed default guarantee.[4]

The Federal Council proposal defines a PLB as[5]

> *a state liquidity provision that is a standard instrument internationally in banking crises. [After the first two lines of defense have been exhausted, the PLB makes it possible] for the central bank to provide additional liquidity which is guaranteed by the state as part of a restructuring of the affected bank. The level of the guarantee is defined on a case-by-case basis depending on the circumstances.*

The proposal envisions that five requirements would have to be met for a PLB to be granted to a SIB[6]:

- Subsidiarity: The SIB's liquid assets, market refinancing options, and any available regular liquidity assistance from the SNB must be exhausted.
- Restructuring: A restructuring procedure must be initiated or imminent, overseen by FINMA, the Swiss financial market supervisor.
- Solvency: The SIB must be deemed adequately capitalized, with solvency either confirmed or ensured by an appropriate restructuring plan approved by FINMA.
- Public Interest: The failure to grant a government-backed liquidity loan must pose a significant threat to the Swiss economy and financial system.
- Proportionality: The liquidity assistance loan must be both necessary and appropriate for the SIB's restructuring.

[3] The Federal Council rejected several alternatives, including the status quo without a legal framework for a PLB or a change of the National Bank Act that would allow the SNB to extend liquidity support to a SIB even if the latter lacked collateral; see pp. 13–14 of the Dispatch. The Council also rejected tighter liquidity regulation measures; see p. 15 of the Dispatch.

[4] See pp. 27–28 of the Dispatch.

[5] https://www.admin.ch/gov/en/start/documentation/media-releases.msg-id-97631.html.

[6] See pp. 29, 40, 42–44 of the Dispatch.

However, the PLB framework would not establish an entitlement for a distressed SIB to a PLB. Final decision powers would rest with the government, after consultation with FINMA and the SNB.

According to the proposal, SIBs would pay a risk-based annual fee to the Confederation as compensation for the potential provision of a default guarantee and to mitigate potential competitive distortions.[7] This fee would be paid into the federal budget, regardless of whether the guarantee were actually granted.[8] In addition, conditional on granting a loan and a PLB, the federal government would be entitled to a provision fee; the SNB would receive interest on the loan; and both the government and the SNB would receive risk premia.[9]

To reduce the financial risks for the Confederation, the proposal introduces a bankruptcy privilege for claims arising from government-backed liquidity loans. In case of bankruptcy, SNB claims and related fees (such as premiums and interest) would be prioritized after the first and second classes of creditors (e.g., after employee wages, social contributions, and privileged deposits). The government guarantee would become effective after the completion of bankruptcy proceedings.[10] In addition, SIBs would have to comply with restrictions during the use of the default guarantee, such as a ban on dividend payments and restrictions on lending to their parent companies.[11]

Article 32c of the proposed revision to the Banking Act outlines the calculation of the ex ante fee.[12] The envisioned fee is risk-based, meaning it is proportional to both the likelihood of the government activating a default guarantee for a particular SIB and the potential extent of that guarantee. The proposed assessment rate is uniform across all SIBs and reflects the overall risk to the Confederation of providing such a guarantee for liquidity assistance loans. It is designed to be based on estimates of potential losses in the event of bankruptcy and would also take into account the SIB's financial performance (e.g., group profit or loss before tax) to ensure affordability.[13]

The assessment base would reflect the specific characteristics of each SIB and be calculated as total exposure (as defined by the denominator of the Basel leverage ratio) minus Tier 1 capital, high-quality liquid assets, and assets designated for SNB collateral.[14]

As a result, SIBs with higher capital or liquidity levels would be subjected to a lower fee. The Federal Council would also factor in the particularities of cantonal state guarantees when determining the fee.[15] Without providing specific details, the proposal suggests an assessment rate ranging from 0.005% to 0.015% (0.5–1.5 basis points (bps)), which would result in total ex ante fees for all SIBs in 2022 of approximately CHF 0.07–0.21bn.[16]

Article 32d of the proposed revision of the Banking Act outlines additional features of the provision fee, risk premia, interest charges, and additional costs.[17] The provision fee is intended to replace—and likely exceed—the ex ante fee. The risk premium for the SNB would cover potential costs that are not offset by interest charges, for instance SNB interest payments on reserve balances or on SNB Bills that are issued to absorb liquidity. The Confederation and the SNB, in consultation with the Confederation, would individually determine the applicable risk premia. The interest rate charged by the SNB would be linked to the policy rate but would not fall below zero. Any additional costs arising from third-party services would be borne by the borrower, regardless of whether the loans are ultimately granted. While the Dispatch does not provide specific quantitative information, it discusses the policy parameters in the context of the Credit Suisse failure (pp. 68 ff).

[7] "Der Umstand, dass der Bund für den Krisenfall eine Ausfallgarantie für Liquiditätshilfe-Darlehen der SNB an eine SIB bereitstellen kann, bedeutet für den Bund, dass er im Fall der Krise einer SIB und bei Erfüllung der gesetzlich festgelegten Voraussetzungen grundsätzlich bereit ist, zugunsten der Sicherung der Finanzstabilität ein gewisses Verlustrisiko einzugehen. Zur Abgeltung dieser grundsätzlichen Bereitschaft des Bundes soll eine entsprechende Pauschale eingeführt werden. Die Möglichkeit, im Krisenfall eine zusätzliche, vom Bund abgesicherte Liquiditätshilfe zu erhalten, wirkt zudem bereits präventiv und hat für sämtliche SIBs einen entsprechenden Wert. Es können ihnen tiefere Refinanzierungskosten anfallen und das Vertrauen ihrer Kunden und Investoren wird gestärkt. Dies führt zu einer Wettbewerbsverzerrung zugunsten der SIBs, die durch die Pauschale kompensiert werden soll" (p. 45 of Dispatch).

[8] See p. 29 of the Dispatch.

[9] See p. 30 of the Dispatch.

[10] See pp. 29–30 of the Dispatch.

[11] See p. 30 of the Dispatch.

[12] See pp. 45 ff, 67 ff of the Dispatch.

[13] "Die berechnete Pauschale muss schliesslich im Vergleich zum Geschäftsergebnis ...verhältnismässig beziehungsweise tragbar sein. Die Pauschale soll einen mit der Einführung einer staatlichen Liquiditätssicherung für SIBs entstehenden Wettbewerbsvorteil kompensieren, soll aber gleichzeitig nicht zu einem Wettbewerbsnachteil führen" (p. 45 of Dispatch).

[14] Presumably, quantitative and qualitative facilitations would be accounted for; that is, only the effective capital and stock of liquid assets would be subtracted. For a discussion of facilitations in the years leading to the Credit Suisse failure, see https://www.parlament.ch/centers/documents/de/9.%20Zellweger.pdf.

[15] Total exposure includes off-balance sheet items; see https://www.bis.org/publ/bcbs270.pdf or https://assets.kpmg.com/content/dam/kpmgsites/ch/pdf/ch-finma-circular-2015-03-en.pdf. See also the reports by UBS Group AG (https://secure.ubs.com/minisites/group-functions/investor-relations/annual-report/2023/digital-ar23-group/digital-ar23-group/index.html#sub_book_0_3) and FINMA (https://www.finma.ch/fr/documentation/publications-finma/kennzahlen-und-statistiken/kennzahlen/kennzahlen-banken/), which show total exposure as "leverage ratio denominator".

[16] According to the Dispatch (p. 46), this amounts to 0.6-—1.8% of pre-tax group profits of all SIBs.

[17] See pp. 46 ff of the Dispatch.

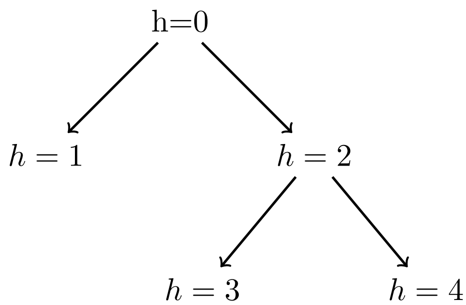

Fig. 1 Event tree

The proposal highlights the importance of ex ante and provision fees in mitigating potential competitive distortions inherent in a PLB framework.[18] Since PLB liquidity assistance enhances the resilience of SIBs in a liquidity crisis but has no direct benefit for non-SIBs, it could lead to lower refinancing costs for SIBs in the market, creating a potential for competitive distortion. Once a default guarantee were granted, this would further alter the competitive dynamics compared to a laissez-faire approach.

3 Conceptual considerations

In the context of the Swiss proposal, a PLB is granted only if, among other conditions, the SIB is deemed solvent and undergoing restructuring. The most likely scenario for a government default guarantee thus involves the SIB reaching the "gone concern" stage, with total loss absorbing capacity fully exploited (initial equity and AT1 bonds fully written off, and Tier 2 convertible bonds converted into new equity). Our discussion focuses on this scenario.[19]

We start by laying out a simple analytical framework to conceptualize the effects of a government intervention such as PLB-backed liquidity support. Thereafter, we use the framework to discuss a series of implications in the context of the Swiss proposal.

3.1 Event tree

There are three periods. The economy starts in history $h = 0$, when bank shareholders issue debt and/or invest equity to fund investments into risky assets. In the following period, there are two histories, $h = 1$ and $h = 2$. In history $h = 1$, the assets generate a high return. In history $h = 2$, the return is low and the bank becomes a "gone concern". There are two possible continuation histories in $h = 2$: In $h = 3$, the bank is liquidated, and in history $h = 4$, it recovers, see Fig. 1.

Let p_1 denote the probability, conditional on history $h = 0$, that $h = 1$ occurs, and similarly p_2 for history $h = 2$. Let p_3 denote the probability, conditional on history $h = 2$, that $h = 3$ occurs, and similarly p_4 for history $h = 4$.

3.2 Actions and payoffs

In $h = 0$, shareholders (or management on their behalf) undertake some action $x \in X \subseteq \mathbb{R}^n, n \in \mathbb{N}$, which includes the choice of scale, i.e., how many assets the bank invests in. In $h = 2$, the government can undertake an intervention $y \in Y \subseteq \mathbb{R}$, for instance, by providing liquidity. Importantly, private choices, x, will depend on the anticipated government action, y.

The shareholder action and government intervention generate a private payoff that accrues to shareholders and bondholders (jointly). In $h = 0$, the shareholder action also generates private costs, $c(x)$. The private payoff in history $h = 1, 3, 4$, respectively, is A_1, A_3, and A_4, where $A_1 > A_4 > A_3 \geq 0$ (limited liability). The ordering of payoffs reflects the fact that bank assets generate high returns in the good history; low returns in the recovery history; and even lower returns in the liquidation history. The private payoffs also include any government transfers.

The shareholder action and government intervention also generate an external payoff that accrues to external stakeholders. The external payoff in history $h = 1, 3, 4$, respectively, is 0, P_3, and P_4, where $P_3 < P_4 \leq 0$.[20] These negative payoffs reflect bank external costs of a bank as gone concern. For example, they may relate to the termination of some projects or even the closure of some enterprises that lost their lines of credit with the deceased bank. The external payoffs also include fiscal consequences for the public sector.

Shareholder and government actions also affect the probabilities. Since the government intervention occurs in $h = 2$, the probabilities p_1 and p_2 depend directly on x and indirectly, through x, on y. The other probabilities may directly depend on x and y. To improve readability, we mostly suppress x and y arguments.[21]

[18] See p. 69 of the Dispatch.

[19] A PLB without complete write offs and conversions would render non-convertible bonds riskier.

[20] The assumption that $P_1 = 0$ is innocuous. Our argument emphasizes the potential conflict between private and social incentives, not their sign (which depends on P_1).

[21] Correia et al. (2024) argue based on U.S. data that "the ultimate cause of bank failures and banking crises is almost always and everywhere a deterioration of bank fundamentals. Bank runs ...are most commonly a consequence of imminent failure. Depositors tend to be slow to react to an increased risk of bank failure, even in the absence of deposit insurance.

3.3 Private and social value of the bank

We assume that the stochastic discount factor for all histories is unity; that is, investors are risk neutral.[22] Accordingly, the value of the bank in $h = 0$ for its owners and bondholders equals

$$A_0(x,y) \equiv p_1(x)A_1(x) + p_2(x)[p_3(x,y)A_3(x,y) + p_4(x,y)A_4(x,y)] - c(x).$$

For society, in contrast, the value of the bank exceeds A_0 by the expected external payoffs

$$\Delta(x,y) \equiv p_2(x) [p_3(x,y)P_3(x,y) + p_4(x,y)P_4(x,y)] < 0.$$

A social planner that values the summed payoffs, which we call welfare, chooses x and y to maximize $A_0 + \Delta$.

3.4 Ex post government intervention

In $h = 2$, the cost is sunk and the government intervenes (chooses y) to maximize the continuation surplus. If the government is concerned about the value of the bank for all stakeholders, it maximizes $p_3(A_3 + P_3) + p_4(A_4 + P_4)$; if it is indifferent about payoffs to bank owners and bondholders and only cares about external payoffs, then it maximizes $p_3P_3 + p_4P_4$.

Note that the burden-sharing arrangement between government on the one hand and bondholders and (old or new) shareholders on the other is irrelevant for the government's intervention if the government is concerned about all stakeholders.[23] This follows from the fact that transfers between the government and the bank do not change $A_3 + P_3$ or $A_4 + P_4$. If the government only maximizes external payoffs, however, then the strength of the intervention generally depends on burden sharing.

In a richer model, the continuation payoffs (A_3, A_4, P_3, P_4) would also depend on private sector choices in histories $h = 3, 4$, and the government intervention in $h = 2$ thus would have incentive effects. The burden-sharing arrangement would then be relevant for the allocation.

3.5 Ex ante shareholder action

Shareholders maximize the portion of A_0 that accrues to them. The shareholder payoffs in histories $h = 1, 3, 4$ equal the payoffs (A_1, A_3, A_4) net of debt repayment. The costs in $h = 0$ equal c net of the funds raised by issuing debt. We denote the face value of promised debt service by D, and the funds raised in $h = 0$ by D_0.

Bondholders anticipate, correctly, that D may not be fully honored in $h = 3$ or $h = 4$, due to limited liability on the part of shareholders. Under the assumption that bondholders have no market power, the funds raised from issuing debt then are given by:

$$D_0 = p_1 D + p_2(p_3 \min[A_3, D] + p_4 \min[A_4, D]), \quad (1)$$

and shareholders maximize

$$p_1(A_1 - D) + p_2(p_3 \max[A_3 - D, 0] + p_4 \max[A_4 - D, 0]) - (c - D_0). \quad (2)$$

3.5.1 Marginal external-cost externality

Suppose first that shareholders take the endogeneity of D_0 into account when maximizing (2). This represents the (unrealistic) case of a debt contract that is contingent on x, or of debt that is contracted once shareholders have chosen x. In such a setting, shareholders maximize

$$\begin{aligned} &p_1(A_1 - D) + p_2(p_3 \max[A_3 - D, 0] + p_4 \max[A_4 - D, 0]) \\ &- (c - \{p_1 D + p_2(p_3 \min[A_3, D] + p_4 \min[A_4, D])\}) \\ =&p_1A_1 + p_2(p_3A_3 + p_4A_4) - c = A_0. \end{aligned}$$

That is, shareholders maximize the expected bank internal asset payoffs. Unlike the social planner, they do not internalize effects on the expected external payoffs Δ. We refer to the derivative of Δ with respect to a generic element of x as the respective marginal "external-cost externality".

3.5.2 Marginal corporate-governance externality

Suppose next that shareholders take D_0 as given when maximizing (2); this represents the (realistic) case of a non-contingent debt contract or of debt contracting before shareholders commit to actions. Shareholders then maximize (2) for given D_0, where D_0 satisfies (1) in equilibrium. The marginal effects in this shareholder program depend on whether limited liability binds or not.

Independently of whether limited liability binds, shareholders disregard the effect of their actions on expected external payoffs. In histories with binding limited liability, they also disregard the effect on bank internal asset payoffs, simply because such payoffs fully accrue to bondholders. In contrast, shareholders do internalize the effect on bank internal asset payoffs in histories without binding limited liability, because in those histories the payoffs accrue to shareholders. We refer to the additional source of distortion due to binding limited liability as the marginal "corporate-governance externality".

For a simple example, abstract from external payoffs (i.e., let $P_3 = P_4 = 0$) and consider a costly action x_i that raises p_4 (and lowers p_3) and does not impact (p_1, p_2) or payoffs. Suppose that costs c are strictly convex in x_i with $\partial c/\partial x_i|_{x_i=0} = 0$. When limited liability binds both

[22] With risk aversion, the asset pricing and efficiency implications we derive would also depend on the covariances between payoffs—both private and external—and consumption.

[23] If the bank is gone concern, the initial shareholders are likely wiped out and some of the initial (convertible) bondholders are the new shareholders.

in $h = 3$ and $h = 4$, then shareholders choose $x_i = 0$ because they do not benefit from incurring costs that improve payoffs for bondholders. In contrast, a planner that internalizes all payoffs chooses $x_i > 0$ because that choice maximizes the total surplus including the part that goes to bondholders. The equilibrium marginal corporate-governance externality in this example equals

$$\frac{d(p_2 p_4 (A_4 - A_3))}{dx_i} > 0,$$

which is the marginal welfare effect not internalized by shareholders. Note that the fact that bondholders break even (in expectation) does not make the corporate-governance externality go away (and even less so the external-cost externality).

3.5.3 Marginal joint externality

Both the external-cost and the corporate-governance externality reflect that shareholders neglect certain consequences for agents other than themselves. When shareholders take D_0 as given, the marginal joint externality of action x_i—the sum of marginal external-cost and corporate-governance externalities—is given by

$$\mathcal{M}_i(x) \equiv \frac{d\Delta}{dx_i} + \frac{d(p_2(p_3 \min[A_3, D] + p_4 \min[A_4, D]))}{dx_i}. \tag{3}$$

Intuitively, $\mathcal{M}_i(x)$ measures how strongly private and social incentives are misaligned at the margin.

3.5.4 Total externality and welfare loss

Let $x^\star(y)$ and $\hat{x}(y)$ denote the action profiles of the social planner and of shareholders in equilibrium, respectively. Both profiles depend on the anticipated ex post government intervention, y, as discussed previously. The total externality $\mathcal{E}$, and thus welfare loss in equilibrium, then equals[24]

$$\mathcal{E} = \sum_{i=1}^{n} \int_{\hat{x}_i(y)}^{x_i^\star(y)} \mathcal{M}_i(x) dx_i.$$

In words, $\mathcal{E}$ represents the total welfare loss resulting from misaligned incentives conditional on anticipated government actions y.

3.6 Welfare effect of ex post intervention

An ex post intervention dy changes marginal externalities by $\{d\mathcal{M}_i/dy\}_{i=1}^{n}$ and alters the total externality, and thus welfare, by

$$\frac{d\mathcal{E}}{dy} = \sum_{i=1}^{n} \left(\int_{\hat{x}_i(y)}^{x_i^\star(y)} \frac{d\mathcal{M}_i(x(y))}{dy} dx_i + \mathcal{M}_i(x^\star(y)) \frac{dx_i^\star}{dy} - \mathcal{M}_i(\hat{x}(y)) \frac{d\hat{x}_i}{dy} \right). \tag{4}$$

This change in the total externality is of key policy interest. It represents the ex ante welfare consequence of the ex post government intervention. Importantly, the welfare consequence may be negative even if the government intervention is optimal ex post and beneficial.

To see this, note that it is unattractive from society's point of view to end up in history $h = 2$. But if $h = 2$ materializes, the government will still find it in society's best interest to intervene, steering the economy toward $h = 4$ rather than $h = 3$ in order to limit social losses. The anticipation of this ex post optimal intervention can affect the incentives of shareholders ex ante and can, paradoxically, induce them to take decisions that make $h = 2$ more likely.[25]

Concretely, suppose that an ex post intervention raising p_4 (and lowering p_3) has the direct effect of increasing A_0 and D_0. The effect on A_0 increases profitability, and the effect on D_0 reduces the need for shareholders to post equity. Maximizing profits, shareholders lever up as much as regulation allows, and the ex post intervention thus raises leverage. This can have the indirect effect of rendering risky investment choices more attractive for shareholders such that the three effects together make the $h = 2$ outcome more likely and reduce $A_0 + \Delta$.

3.7 Interpretation and discussion

3.7.1 Leverage, limited liability, and external payoffs cause distortions

The origin of the corporate-governance externality is leverage combined with limited liability, as (2) makes clear. If D and thus D_0 equaled zero, shareholders would internalize the full consequences of their actions for bank internal payoffs. Leverage and limited liability induce shareholders to internalize these payoffs only to the extent that they accrue to themselves, i.e., to the extent that the bank internal payoffs exceed the contractual debt service. High leverage makes this less likely and thereby fosters the corporate-governance externality.

The consequence of the corporate-governance externality is that the trade-offs that shareholders perceive when deciding on their actions differ from the trade-offs faced by society. This can lead to decisions that destroy social value. For example, shareholders might find a risky investment opportunity attractive because it nicely pays

[24] When shareholders take the endogeneity of D_0 into account, $\mathcal{M}_i$ reduces to $d\Delta/dx_i$.

[25] Kydland and Prescott (1977) pioneered the analysis of the inconsistency of optimal policy plans.

off in $h = 1$, where shareholders benefit, irrespective of the fact that the investment incurs large losses in $h = 3$ and $h = 4$, where shareholders have no stake due to limited liability.

Similar forces are at work in the context of the external-cost externality: The trade-offs that shareholders perceive when deciding on their actions disregard the collateral damage of the bank as gone concern for stakeholders outside of the bank.

3.7.2 Legal framework versus power of the factual

By definition, the ex post government intervention maximizes continuation surplus conditional on having reached history $h = 2$. This implies that the government always has an incentive to intervene in $h = 2$, regardless of whether a legal framework exists to support such an intervention. Once a SIB is in distress, the government's choice is not so much about whether to intervene, but rather about how to do so in the most efficient manner.

In the context of liquidity support and a PLB, this raises the question of why PLB legislation should be established in the first place. One rationale could be that the absence of a framework makes it politically or practically impossible to provide liquidity support. But this is clearly not the case as past emergency legislation shows—liquidity support will most likely be provided one way or the other.[26] Another rationale could be that a legal framework is required for corrective measures ex ante (that we discuss below) and to specify how costs of intervention, if they arise, are to be allocated among government authorities. This rationale applies in the Swiss case. Yet another rationale for developing a formal framework is that it can foster advance emergency planning, thereby improving ex post policy responses and allowing policymakers and market participants to anticipate potential political constraints. This, in turn, can help reduce policy uncertainty.

A more binding limit to the liquidity support could be that the SIB is "too big to save". When the SNB provides liquidity to a distressed SIB, it credits the bank's sight deposit account at the SNB with additional balances. In return, the SNB receives a claim against the bank, promising future repayment. If the liquidity is provided under the PLB, this claim is guaranteed by the Confederation. While the SNB can, in theory, create unlimited amounts of CHF liquidity—and thus always bail out a SIB with CHF liabilities—the Confederation's finite capacity to collect taxes constrains the amount that can credibly be guaranteed. This constraint can render a SIB "too big to save", particularly if the SNB is committed to rejecting (or trying to reject) Confederation guarantees that lack credibility and could force the SNB to absorb huge losses with negative consequences for price stability.[27]

3.7.3 Fiscal consequences

The ex post government intervention has fiscal consequences, reflected in A and/or P, which may be positive or negative. It is fiscally sound when the net fiscal costs to the consolidated government are no greater than zero.[28] However, fiscal soundness will not (and should not at this point) be the primary consideration in deciding whether to intervene. As explained above, the key factor will and should be whether the broader societal benefits, net of costs, are positive. This is likely the case, as failing to provide support could lead to severe disruption.

If policy makers want to ensure fiscal soundness they must be wary of the ex post bargaining position they might find themselves in when determining the terms of conditions of the intervention. The power of the factual described above can weaken that position.[29] One potential strategy to addressing this problem is to try to recover expected losses by way of ex ante compensations.

Liquidity support, in particular, exposes the consolidated government to the risk that the SIB may be unable to repay the support. If the PLB guarantee is effective, this risk is borne by the Confederation; if it is weak or uncertain, the Confederation effectively shifts risk to the (other) SNB shareholders, in particular cantons.[30] The net fiscal cost to the consolidated government is the amount of liquidity support provided, less the discounted value of the risky repayments from the SIB.[31]

If the Confederation bears the default risk, then it is reasonable to expect this to be remunerated. The treasury is also the natural recipient of any corrective taxes and fees levied ex ante. In contrast, the risk-free interest rate on the liquidity support should accrue to the central bank, as it is the entity providing the liquidity.

3.7.4 Debt subsidies accrue to shareholders

As noted before, the ex post government intervention maximizes the continuation surplus conditional on

[26] This also implies that we should not expect existence of a formal PLB framework to correlate with SIB ratings or other risk measures.

[27] The SNB may also be unwilling to extend liquidity support in the event of a conflict between the authorities. Assessing a bank's solvency is notoriously difficult, and FINMA's assessment could be contested. Eventually, the Confederation will almost certainly have the upper hand.

[28] If the liquidity support is fiscally sound, one may question its need: Why should the government rather than the private sector intervene, when the intervention is profitable? One rationale could be that large liquidity support requires the central bank, at least as an enabler of coordinated support.

[29] See Flanagan and Purnanandam (2024) on ex post renegotiation of contract terms in the context of the TARP program.

[30] Absent a PLB, any losses on loans to banks are borne by the SNB. Since part of the SNB's profits—and thus losses—are distributed to the cantons, the latter would bear a share of the losses.

[31] Discounting occurs at prevailing market rates or, ideally, the government stochastic discount factor. For the latter, see, for example, Farhi (2010).

having reached $h = 2$. Since the bank internal value A is positively correlated with the bank external value P, this implies that the intervention also improves A. More specifically, as the initial shareholders and owners of junior debt tranches have been wiped out at $h = 2$, the intervention benefits the holders of senior non-convertible debt by increasing their expected payoff when the bank is gone concern. As a consequence, senior debt holders require a lower risk premium, D/D_0, leading to lower funding costs for the SIB.

In our model, bondholders have no market power. In equilibrium, they (just) break even and the reduced risk premium thus benefits shareholders, who need to post less equity to collect A_1 in $h = 1$. That is, while the government intervention insures and subsidizes bondholders ex post, the value of that subsidy accrues to shareholders ex ante.[32]

In our empirical analysis in Sect. 4, we find a priced debt risk premium that is low compared to the fundamental risks reflected in the SIB balance sheet. This suggests market expectations of a government intervention that increases payments to bondholders, presumably because the government feels compelled to limit the social costs of a bank as gone concern. While this intervention is beneficial ex post—non-intervention would imply even higher costs—it benefits shareholders ex ante.

3.7.5 Liquidity support as TBTF-intervention

Liquidity support backed by a PLB affects senior non-convertible debt prices in parallel to other support measures for a TBTF SIB. Consider for example the recapitalization of a distressed SIB with the aim to guarantee its solvency in order to strengthen the stability of the financial system. Senior bond holders are made whole as a consequence of such a recapitalization, and senior debt claims thus carry a lower risk premium, exactly as in the case of liquidity support.

Since the liquidity support backed by a PLB is tied to a bank's systemic importance, its effect on debt pricing is one among potentially many components that collectively give rise to a TBTF subsidy for SIB debt holders. As the TBTF status cannot be separated from PLB access, it is difficult to empirically identify the individual components. In Sect. 4, we therefore provide an estimate of the total TBTF subsidy and funding advantage.

[32] If bondholders had market power, they would collect rents and not just break even. Only in the extreme case where bondholders fully appropriate the benefits from the government intervention do shareholders not profit directly.

3.7.6 Beneficial ex post interventions may be harmful ex ante

Equation (4) illustrates that ex post beneficial interventions may increase externalities and be harmful ex ante. An important example is the one given at the end of Sect. 3.6, namely an ex post intervention to limit social losses of bank distress, which raises leverage and fosters excessive risk-taking to generate negative externalities. As this example makes clear, the primary concern for policymakers should not be the intervention's effect on the subsidy to bondholders (possibly appropriated by shareholders), nor the effect on the different marginal externalities. The key concern for policymakers should be shareholders' actions and the externality $\mathcal{E}$ itself.

With multiple banks, the economy-wide externality can be even broader than $\mathcal{E}$ because of distortions in market structure. Ex post interventions in $h = 2$ that only benefit some type of (systemically important) banks, reduce the ex ante funding costs of those banks but not of others. Such favoring of the former type of banks undermines fundamental forces of comparative advantage and distorts the equilibrium allocation.

3.7.7 Corrective measures

We have emphasized that $\mathcal{E}$ is a conglomerate of cumulative wedges that reflect external-cost and corporate-governance externalities as well as other distortions, all of which may be modulated by the impact of the ex post government intervention. Corrective measures to avoid welfare losses must neutralize these wedges.[33] The question is, how this can best be achieved, in particular, whether corrective measures should best be applied in a piecemeal fashion or comprehensively and holistically, and whether they should be applied ex post or ex ante. While our framework lacks the structure to yield definite answers, it suggests disadvantages of the ex post and piecemeal approach.

Suppose that the goal is to neutralize the (additional) distortion from the ex post government intervention, specifically the ex ante incentive to excessively take risk due to binding limited liability and ex post liquidity support, as described earlier. Ex post corrective measures (imposed in $h = 3$ or $h = 4$) to neutralize this incentive are limited by the fact that they lack any direct bite ex ante, because binding limited liability renders changes in bank internal payoffs irrelevant for shareholders ex ante. Effective ex post corrective measures therefore would have to indirectly affect shareholder incentives, by changing the price of debt ex ante. But this would require to (partly) undo the ex post intervention, specifically debt subsidization, throwing out the baby with the bathwater.

[33] See Keister (2016) on appropriate measures to correct bailout distortions.

For example, harsh financing conditions attached to the liquidity support could not only be hard to negotiate (see above), but also counterproductive if they end up tightening rather than relaxing the SIB's financing constraints.

Corrective measures applied ex ante suffer to a lesser extent from such problems. But they may still be difficult to implement if they follow a piecemeal approach that tries to neutralize distortions individually. Such a piecemeal approach would require close coordination, which is difficult to achieve in practice, where different authorities are involved and exposed to varying lobbying efforts. The theory of the second best suggests that the end result of uncoordinated measures, each with the intent of addressing an individual distortion, may lead to a worse outcome than doing nothing. A piecemeal approach therefore is likely less effective than an approach that directly focuses on $\mathcal{E}$ and its main drivers, namely leverage, limited liability, and external payoffs.[34]

Unlike the approach envisioned in the Swiss PLB proposal, corrective measures applied ex ante should not depend on the SIB's financial performance, which reflects past choices and luck. They should focus on $\mathcal{E}$ and its main drivers. In addition, these measures need not be limited to taxes or fees. Quantity restrictions on equity and other regulatory tools can have similar corrective effects.

It is sometimes argued that corrective measures increase the cost of bank lending or other socially valuable bank activities. Board (2020) emphasizes the distinction between private and social costs and benefits and finds "significant net benefits for society resulting from TBTF reforms. Observed changes suggest increases in resilience, no material increases in the costs of funding, and more market discipline. Potentially negative side effects, such as a fall in aggregate lending or greater unintended fragmentation of financial markets, have not been observed. Where SIBs have reduced their activities, other suppliers of financial services have stepped in" (p. 7). De Nicoló et al. (2021) argue on theoretical grounds that higher capital requirements raise bank profitability and support the banking sector's lending capacity after a short-term credit crunch. Their panel VAR estimates suggest that bank lending increased as a consequence of Basel III capital regulation.

3.7.8 Aggregate risk and precautionary saving

Since P_3 differs from P_4 (and from P_1) the bank's presence exposes society to aggregate risk. The public sector faces default risk on its liquidity support, and the broader public faces various macroeconomic risks. The natural response to such risks is to increase precautionary saving. Both the government and the private sector should build physical capital and net foreign asset buffers that can help withstand potential adverse outcomes.

A priori, there is no reason for the SIBs that generate the risks to fund this precautionary saving (as long as the corrective measures discussed above achieve the desired effect). But the need for asset accumulation should be factored into the societal cost–benefit analysis when evaluating the merits of the presence of a SIB.

This also holds true in the PLB context. In a positive scenario, the liquidity support enabled by the PLB is successful and the SIB repays it. In a negative one, resolution fails and the public sector suffers losses even if the liquidity support was extended on actuarially fair terms.[35] Macroeconomic outcomes may also be adversely affected, as a SIB crisis followed by a failed resolution can depress economic activity, endanger price stability, and harm the reputation of the Swiss financial sector as well as Switzerland's broader international standing.

3.8 Summary

We draw several conclusions from these conceptual considerations.

First, high leverage, limited liability, and SIB external payoffs cause distorted shareholder and management choices.

Second, the distortions impose societal costs and increase the risk that the government is compelled to intervene, possibly resulting in higher government debt, taxes, and inflation. The presence or absence of a legal framework supporting government intervention is of secondary importance for actual policy choices, even though it may reduce policy uncertainty and facilitate planning. For whenever it is beneficial ex post, the government will find ways to intervene. To secure fiscal soundness of anticipated interventions, the government may rely on compensation ex ante.

Third, liquidity support, like other TBTF support measures, subsidizes non-convertible bond financing. This benefits shareholders and encourages excessive leverage and risk-taking by SIBs, amplifying the fundamental distortions. Since the liquidity support backed by a PLB is tied to a bank's systemic importance, it is difficult to empirically identify the individual components

[34] A piecemeal approach may also promote unhelpful expectations. For example, an ex ante tax as compensation for likely access to PLB-backed liquidity support could foster the expectation that such support will be forthcoming, thereby lowering debt funding costs and fostering balance sheet growth and risk-taking.

[35] In the wake of the great financial crisis, government support measures for Royal Bank of Scotland, Fortis Bank, and Commerzbank AG generated losses (https://www.faz.net/aktuell/finanzen/commerzbank-und-bankenrettung-ein-potenzielles-verlustgeschaeft-19965723.html). Flanagan and Purnanandam (2024) argue that TARP investments delivered subpar returns to taxpayers, not least because ex post renegotiation of contract terms.

that collectively give rise to a TBTF subsidy for SIB debt holders.

Fourth, regulation should holistically address the negative consequences of the overall TBTF subsidy for SIBs. A comprehensive set of corrective measures should apply ex ante and may include taxes, fees, quantity restrictions on equity, or other regulatory tools. Corrective measures should not be contingent on the SIB's current financial performance.

Fifth, the presence of SIBs and the potential for their failure introduce aggregate risk and call for additional precautionary savings. The need for stronger precautions should be factored into the societal cost–benefit analysis when evaluating the merits of the SIB presence in a country.

4 Implicit TBTF subsidies

We have argued that ex post measures aimed at stabilizing TBTF SIBs, including liquidity support with a government-backed default guarantee, fail to properly incentivize initial shareholders and management. In fact, they may achieve the opposite by effectively subsidizing non-convertible debt and reducing the bank's ex ante financing costs. Using the notation of Sect. 3, the interest rate on debt, D/D_0, is lower with government intervention. Since this intervention affects bank managers' and shareholders' choices x, it can lead to higher welfare losses. In particular, as argued in Sect. 3.6, it may lead to excessive risk-taking.

In the following, we attempt to quantify this implicit subsidy, which generates a need for ex ante corrective measures, such as stricter equity requirements or taxes targeting risky bank activities or balance sheet positions. We note that the implicit subsidy of interest results in a funding cost advantage for SIBs, unless there are other guarantees with a similar effect that benefit smaller banks.

Recall that the Swiss proposal suggests ex ante fee amounts based on an assessment rate ranging from 0.5 to 1.5bps (0.005%-–0.015%) and totalling CHF 0.07–0.21bn in 2022. While we compare our findings to this range from the Swiss proposal, we emphasize that the comparison should be interpreted with caution, as we focus on the full TBTF subsidy reflecting government interventions to support SIBs that reach the gone concern stage. As discussed earlier, expected PLB support and TBTF status cannot be easily disentangled. Compensatory and corrective measures for SIBs therefore should be designed as a comprehensive package.

4.1 Our estimate

To price the implicit TBTF subsidy, we calculate by how much it lowers a SIB's cost of funding. We use credit default swaps (CDSs), which serve as insurance against bond defaults. The CDS spread represents the cost of this insurance, expressed as a percentage of the bond's value.

Without a government guarantee, bondholders seeking to protect their investment must purchase CDS protection, which reduces their net return to the bond interest rate minus the CDS spread. With a government guarantee, bondholders need to buy less protection—or none at all if the guarantee is perfect—resulting in a higher net return. Consequently, a non-guaranteed bank must offer a higher interest rate to compete, covering the CDS spread. This interest rate differential, equal to the CDS spread, reflects the funding advantage provided by the government guarantee.

4.1.1 Motivation

For didactic reasons, we start with a simple example to make our main argument. Assume that with probability $1-p$, the SIB experiences financial distress, while with probability p (the "survival probability"), it remains solvent and liquid. For now, we treat p as given, but we endogenize it in the full model. We compare two scenarios: a realistic one, in which the government (including the central bank) intervenes in the event of distress, facilitating the resolution of the SIB and repayment of its senior debt; and a counterfactual scenario, in which the government refrains from intervention, leading to the collapse of the SIB. In both scenarios, we assume that initial shareholders as well as holders of AT1 and Tier 2 convertible bonds are completely wiped out.

Without government intervention, the recovery rate R on senior debt is significantly below unity, due to bankruptcy costs and fire-sale losses on the remaining assets. As explained above, a credit default swap (CDS) insures against these losses. For each CHF invested in senior debt, the expected insurance benefit is CHF $(1-p)(1-R)$, as distress occurs with probability $1-p$ and the insurance covers the loss CHF $(1-R)$. The actuarially fair premium for the CDS contract costs CHF c^*, where

$$c^* = \frac{1-p}{p}(1-R)$$

ensures that the expected payment to the insurer when the SIB survives, CHF c^*p, matches the expected payment from the insurer to the senior debt holders when it does not.[36]

[36] The formula also applies when the insurance arrangement spans multiple periods, or in a continuous-time framework. Consider an arrangement lasting T periods. Let $q \equiv p/(1+r)$, where r denotes the interest rate. The present value of the insurance premiums is CHF $c^*p(1+q+q^2+\ldots+q^{T-1})$, and the present value of insurance payouts is CHF $(1-R)(1-p)(1+q+q^2+\ldots+q^{T-1})$. Both are equal when

With government intervention, in contrast, financial market participants expect a higher recovery rate in a distress scenario,[37] rendering insurance cheaper: the observed CDS spread, $\tilde{c}$, falls below c^*. Following standard practice, we interpret the difference between the counterfactual spread c^* and the observed spread $\tilde{c}$ as a measure of the reduction in the bank's financing costs that results from expected government support tied to the bank's SIB and TBTF status. In other words, the gap between the CDS premiums in the two scenarios reflects the "TBTF subsidy rate" for senior debt.[38] Formally, this subsidy rate, s^{TBTF}, is given by

$$s^{\text{TBTF}} = c^* - \tilde{c} = \frac{1-p}{p}(1-R) - \tilde{c}. \quad (5)$$

US data suggests recovery rates R of 77% and far lower.[39] Furthermore, the CDS spread for senior debt of UBS Group AG (UBS) in 2022—the baseline year for our calibration and the Swiss proposal—was 84.79bps, so we set $\tilde{c} = 0.85\%$.[40] The solid black line in Fig. 2 illustrates the implied subsidy rate, s^{TBTF}, as a function of the bank's solidity, measured by the annual survival probability p, when $R = 0.7$. We see that a survival probability of 90% is associated with an implied subsidy rate of 2.5%. Even with p as high as 94%, senior debt remains subsidized at a rate exceeding 1%. The implied subsidy disappears (i.e., falls below zero) when the survival probability reaches 97.25%.

The red line in Fig. 2 represents the average assessment rate under the Swiss PLB proposal, which stands at 0.01%. While the assessment rate is applied to a base that does not precisely match the quantity of senior debt, it nonetheless provides a valuable reference point for evaluating the subsidy rate. The comparison shows that the proposed assessment rate is very low unless one assumes the SIB to be extremely solid: s^{TBTF} exceeds 0.01% unless the survival probability p is greater than 97.22%. To contextualize, an annual survival probability of 97.22% implies an expected duration of nearly 36 years between consecutive distress events, while a survival probability of 95% corresponds to an expected duration of 20 years.[41]

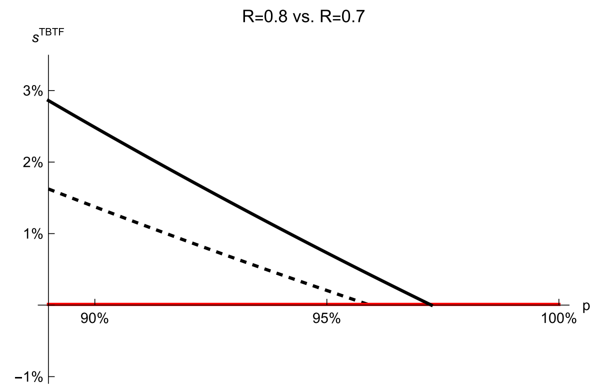

Fig. 2 Relationship between survival probability, p, and implied subsidy rate, s^{TBTF}, when $R = 0.8$ (black dashed) and $R = 0.7$ (black solid); assessment rate under the Swiss PLB proposal (red)

These results change when we assume that senior debt holders are less reliant on government support, i.e., when the recovery rate R absent government intervention is higher. The dashed black line in Fig. 2 illustrates the relationship between the survival probability and the implied subsidy rate when $R = 0.8$ rather than 0.7. While the implied subsidy rate decreases substantially, it still exceeds the proposed assessment rate unless the survival probability exceeds 95.89%, corresponding to an expected duration of more than 24 years between consecutive distress events. In other words, through the lens of the model and with $R = 0.8$, the proposed assessment rate continues to be very low unless one assumes the SIB to be extremely solid.

4.1.2 Quantitative assessment

The analysis thus far treats the distress probability $1-p$ as exogenous. To discipline our conclusions, we adopt a standard approach that models distress risk as the probability that the bank's randomly fluctuating asset value falls

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[36] (Continued)

$c^* = (1-p)/p(1-R)$. Analogous conclusions can be drawn in a continuous-time framework. Assume the SIB survives for a duration t with probability $p(t)$, such that the instantaneous probability of distress after duration t is $-p'(t)$. The insurance premium CHF c^* is paid continuously until a distress event occurs. In this case, the actuarially fair arrangement satisfies the condition $c^* \int_0^\infty p(t)\exp(-rt)dt = (1-R)\int_0^\infty -p'(t)\exp(-rt)dt$. If $p(t) = \exp(-\mu t)$, with $\mu > 0$, this results in $c^* = \mu(1-R)$.

[37] They might also expect p to increase.

[38] We abstract from counter party risk and illiquidity in the CDS market. Accounting for counter party risk (the risk that the insurance provider defaults) would increase the estimated TBTF premium (see p. 84 in Zhao (2018)). Conversely, accounting for illiquidity might reduce it. We assume that the CDS market does not anticipate/price in TBTF support before resolution.

[39] See Bennett and Unal (2015) and Table 1 in Begenau and Landvoigt (2022).

[40] Long-term averages of senior debt CDS spreads of UBS and Credit Suisse Group AG are of a similar magnitude. We use daily data from Refinitiv for 5-year CDS spreads on senior unsecured debt. From 2010 to 2024, the average CDS spread for UBS (UBSJ5YEUAM=R) was 77bps, and for Credit Suisse Group AG (CSGN5YEUAM=R), 103bps. From 2004 to 2024, the average spreads were 71 and 87bps, respectively. We use 5-year CDS contracts rather than annual contracts because of their higher liquidity.

[41] This assumes independence of distress events. Note that $\sum_{t=1}^{\infty} tp^{t-1}(1-p) = 1/(1-p)$.

below the level of its senior debt Merton (1974), i.e., below the level of liabilities net of convertible debt and equity. With a specified recovery rate R, the model-implied distress risk translates into the actuarially fair premium for insurance against losses on the bank's senior debt, c^* Finkelstein et al. (2002)[Equation (2.15)]. This premium then determines the implied subsidy rate, $s^{\text{TBTF}} = c^* - \tilde{c}$. Similar modeling approaches are used, for example, in Lambert et al. (2014) and Allenspach et al. (2021).

Credit Grade Model.

We construct a theoretical CDS spread measure using a structural model proposed by Finkelstein et al. (2002), and known as the CreditGrade model. We will refer to this paper as CG going forward. CG applies their methodology to non-financial as well as financial corporates, and it has become a standard in the literature to estimate theoretical CDS spreads, although there are differences in how the model is calibrated. Here we show the main equations of the CG model and we refer the interested reader to Finkelstein et al. (2002) for the details.

CG assumes that the firm's assets V_t follows a diffusion process,

$$\frac{dV_t}{V_t} = \mu dt + \sigma_V dW_t, \tag{6}$$

where μ is a constant drift term, W_t denotes a Brownian motion, and σ_V indexes the asset growth volatility. CG assumes that $\mu = 0$ and that the firm's debt is fixed over the horizon of interest. As a consequence, expected leverage is fixed. The firm defaults when V_t falls below some default threshold, LD, where L is the average recovery rate of firm debt D. CG discusses that with a fixed threshold LD the model underestimates the default probability. As a remedy, CG introduces a stochastic default threshold by assuming that L is distributed according to a lognormal distribution, with mean $\bar{L}$, and percentage standard deviation λ, so that

$$LD = \bar{L}De^{\lambda Z - \lambda^2/2}, \tag{7}$$

where Z is a standard normal random variable. Given these assumptions, the survival probability of the firm from now (date 0) to date t is

$$p(t) = \Phi\left(-\frac{a_t}{2} + \frac{\log(d)}{a_t}\right) - d\Phi\left(-\frac{a_t}{2} - \frac{\log(d)}{a_t}\right) \tag{8}$$

with

$$d = \frac{E + \bar{L}D}{\bar{L}D}e^{\lambda^2}$$

and

$$a_t = \sqrt{\sigma_V^2 t + \lambda^2},$$

where $\Phi(\cdot)$ denotes the normal cumulative distribution function, and E is the equity value at date 0.

Equipped with the survival probability of the firm, it is now possible to price protection (a CDS) against losses on debt D by equating the present (expected) values of the protection premium payments c^* to the CDS seller and insurance payouts from the CDS seller in case of losses on the debt. For protection with duration t, the CG model yields a (risk neutral) premium $c^*(t)$ equal to

$$c^*(t) = r(1-R) \frac{1 - p(0) + e^{r\xi}\left[G(t+\xi) - G(\xi)\right]}{p(0) - p(t)e^{-rt} - e^{r\xi}\left[G(t+\xi) - G(\xi)\right]}, \tag{9}$$

where r is the risk-free interest rate, R denotes the recovery rate over the class of senior debt in the absence of government insurance, and $\xi = \lambda^2/\sigma^2$. The function G is

$$G(u) = d^{z+1/2}\Phi\left(-\frac{\log(d)}{\sigma_V\sqrt{u}} - z\sigma_V\sqrt{u}\right) + d^{-z+1/2}\Phi\left(-\frac{\log(d)}{\sigma_V\sqrt{u}} + z\sigma_V\sqrt{u}\right)$$

with $z = \sqrt{1/4 + 2r/\sigma_V^2}$.

As discussed before, the spread $c^*(t)$ is the hypothetical insurance premium that a protection seller (CDS issuer) would accept in exchange for providing insurance against losses on debt, in the absence of any government guarantee. $c^*(t)$ is higher than the CDS premium $\tilde{c}(t)$ observed in the data when debt holders expect to benefit from a government bailout. Then, $c^*(t) - \tilde{c}(t)$ is the subsidy rate that a TBTF bank receives on its debt.

Standard Calibration.

CG calibrates $\bar{L} = 0.5000$ and $\lambda = 0.3000$ based on Portfolio Management Data and Standard & Poor's database. CG approximate σ_V based on data on share price variability, using an (approximate) relationship between the volatility of equity price growth and the volatility of asset value growth given by

$$\sigma_V = \sigma_S \frac{S \times \text{share price}}{S \times \text{share price} + \bar{L}D} = \sigma_S \frac{E}{E + \bar{L}D},$$

where S denotes the stock price and σ_S the equity price growth volatility. For σ_S, CG uses 1000-day historical volatility estimates. We follow this approach and consider the 300-, 600-, and 900-day historical averages of the stock price volatility of UBS, selecting the highest and lowest volatilities as bounds. For the recovery rate R, we use the range 48%–77% based on US studies. Finally, we set the risk-free rate to $r = 0.4858\%$, the average yield

Table 1 New calibration

	Value or range	Source
σ_V	[0.0531, 0.2563]	Extrema of estimated asset growth volatility, Refinitiv data
λ	0.0000	Conservative assumption
$\frac{V}{LD}$	1.1054	Maximum TLAC share (2022), UBS annual reports
r	0.4858%	2022 average risk-free rate on 5-year Swiss Confederation bonds, Refinitiv data
R	0.7700	Optimistic historical average Bennett and Unal (2015)

on 5-year government bonds in 2022.[42] Table 3 in the Appendix summarizes the CG calibration, which we refer to as "standard calibration".

Based on this calibration and for $R = 0.48$, we obtain the range [1490, 1496]bps for the theoretical 5-year CDS spread in 2022, $c^*_{CG,2022}(5)$. For $R = 0.77$, we obtain the range [659, 661]bps.

New Calibration.

To better capture the specific characteristics of the Swiss context, we re-calibrate the CG model, emphasizing the distinction between senior debt and TLAC. In CG, the firm defaults when its assets fall below LD, the average recovery rate of all bond categories on the firm's balance sheet once in bankruptcy. We find it more natural to interpret $(1-L)D$ as the value of the bonds that can be converted into equity or devalue (e.g., AT1, AT2 bonds) before or at the time of bankruptcy. This is relevant in the context of the PLB discussion, because the Swiss proposal foresees that the PLB will only be triggered once all subordinated debt has been wiped out. Therefore, our interpretation of CG interprets the probability of bankruptcy as the probability that UBS will access the PLB. Since we seek a conservative estimate of the TBTF subsidy rate, we assume that all bonds that contribute loss-absorption capacity are completely wiped out before the government intervenes. Moreover, we posit that UBS' loss-absorption capacity will be stable at the historical maximum attained in 2022.

Rather than relying on share price data as in the CG calibration, and to align with our interpretation of the model, we estimate σ_V using maximum likelihood estimation based on historical UBS data.[43] Our estimates of σ_V vary significantly across different time periods. Specifically, we find $\sigma_V = 0.2563$ for the period 1995–2005; 0.1556 for 2005–2015; 0.0531 for 2015–2022; and 0.2049 for the full 1995–2022 period. We report results for the whole range of estimates. The most conservative estimate, $\sigma_V = 0.0531$, implies the smallest TBTF subsidy rate.

We set the risk-free rate to $r = 0.4858\%$ and the recovery rate on senior debt (in the absence of government intervention) to $R = 0.77$. As explained before, this constitutes again a conservative approach. Figure 4 in the Appendix illustrates the time series of the data we use and Table 1 summarizes the calibration.

Results.

Next, we express (9) as a function of R, $c^*(t) = (1-R)X^{cal}(t)$, where

$$X^{cal}(t) \equiv r\frac{1 - p(0) + e^{r\xi}[G(t+\xi) - G(\xi)]}{p(0) - p(t)e^{-rt} - e^{r\xi}[G(t+\xi) - G(\xi)]}$$

can be interpreted as a default factor and can be computed based on our calibration. Given the range for σ_V, $X^{cal}(5)$ lies in a range as well, namely $X^{cal}(5) \in [0.1074, 0.8453]$. For $R = 0.77$, the theoretical CDS spread thus satisfies

$$\begin{aligned} c^*(5) &\in (1-0.77) \times [0.1074, 0.8453] \\ &= [0.0247, 0.1944]. \end{aligned}$$

To calculate the TBTF subsidy rate, we subtract the observed CDS spread for senior debt, $c^*(5) = 0.8479\%$.[44] The subsidy rate then satisfies

$$\begin{aligned} s^{\text{TBTF}}(5) &\in [0.0247, 0.1944] - 0.8479\% \\ &= [0.0162, 0.1859], \end{aligned}$$

that is, it lies between one and nineteen percent. Parallel calculations for the CG calibration yield the tighter range [0.0574, 0.0577], i.e., a subsidy rate of nearly six percent. Its main message is that, even under the most conservative assumptions, UBS benefits from a TBTF subsidy rate of more than 1.6%.

To derive an estimate of the absolute value of TBTF subsidies, we multiply the estimated subsidy rate with the amount of senior debt. An important question is whether deposits belong to this category. While some

[42] Using the 5-year forward swap rate gives essentially the same results.

[43] We include the trend μ in the estimation equation but do not report it. If assets are not always marked to market, we might under estimate σ_V.

[44] We use the 2022 annual average from Refinitiv series UBSJ5YEUAM=R.

Table 2 Lower bounds for estimated TBTF subsidy

	Standard calibration	New calibration
UBS subsidy excl. deposits	USD 10.3bn	USD 2.9bn
UBS subsidy incl. deposits	USD 41.1bn	USD 11.6bn

authors argue that deposits are covered by deposit insurance and therefore should be excluded,[45] the matter is more complicated for UBS as the Swiss deposit insurance system would not be able to cover all UBS depositors. In other words, deposits of a SIB may still benefit from TBTF guarantees, even if the deposit insurance system covers deposits at smaller banks. We leave the decision on this matter to the reader and report the TBTF subsidy for insured senior debt both including and excluding deposits.

In 2022, UBS reported deposits valued at USD 536bn, total debt of USD 228bn, equity of USD 57bn, and TLAC of USD 105bn, such that subordinated debt equaled USD $(105-57)$bn $=$ USD 48bn. We conclude that senior unsecured debt excluding deposits totaled USD $(228-48)$bn $=$ USD 180bn, while unsecured debt plus deposits equaled USD $(536+180)$bn $=$ USD 716bn. Using the lowest estimates of the TBTF subsidy rate on senior debt, this yields the subsidy amounts USD 11.6bn or USD 2.9bn, including or excluding deposits, respectively; see Table 2. For comparison, UBS's net profit in 2022 was USD 7.2bn.

Robustness.

Figure 5 in the Appendix illustrates that the estimated TBTF subsidy rate is highly sensitive with respect to the recovery rate, R. Figure 6 in the Appendix illustrates how it varies with the TLAC ratio and asset volatility. Ceteris paribus, the estimated subsidy rate would fall to zero if either asset volatility decreased to 0.0323 or the ratio $V/(LD)$ increased to 1.1817. With an asset volatility of 0.0420 (in line with estimates by Bastos e Santos et al. (2020), Table 15c) the estimated subsidy rate equals roughly 0.75%.

Summary.

The standard calibration based on Finkelstein et al. (2002) yields a TBTF subsidy rate of UBS senior debt in 2022 in a range around 5.74% when we set $R=0.77$—a conservative value in the sense that it should lead us to under- rather than overestimate the TBTF subsidy rate. Our preferred calibration, which emphasizes the distinction between senior debt on the one hand and total loss-absorbing capacity (TLAC, composed of equity and subordinated debt) on the other, yields a subsidy rate of at least 1.6% and a total subsidy (excluding deposits) of USD 2.9bn.

4.2 Estimates in the literature

A meta-analysis by the Bank for International Settlements yields 106 estimates of the funding cost advantage of SIBs based on 19 studies for banks in several countries. The mode of the estimates is in the 20–30bps range, 60% of the estimates lie in the 0–50bps range, and the minimum and maximum estimates are −10 and 350bps, respectively.[46] In the following, we focus on studies that specifically consider the Swiss case.

Allenspach et al. (2021) measure the TBTF subsidy based on extensions of the Merton (1974) model, specifically the CreditGrades model (that we also use) and Moody's CreditEdge model. They refine these approaches by incorporating the effect of Contingent Convertible bonds and bail-in bonds, finding that while these instruments reduce the TBTF subsidy, they do not completely eliminate it. The results reveal that the TBTF issue remains specific to the banking sector, as large non-financial firms do not benefit from a similar subsidy. While the TBTF subsidy for banks has decreased since the peak of the Global Financial Crisis, it remains higher than pre-crisis levels. Allenspach et al. (2021) identify significant regional differences, with European banks generally experiencing a more pronounced TBTF subsidy than U.S. banks, especially since 2017.[47] The estimated TBTF subsidy rate for Swiss SIBs amounts to around 400bps in the period 2008–2018; it increased to 1000bps at the onset of the Covid crisis, see Fig. 3.

Lambert et al. (2014) report several estimates of implicit subsidies. Using CDS spreads and Moody's CreditEdge model, they find a subsidy rate of approximately 50bps in 2008 and around 175bps in 2013 for Swiss SIBs.[48] Based on credit ratings, they estimate a subsidy rate of about 100bps in 2009, but only around 15bps during calmer periods.[49] The authors estimate the value of TBTF subsidies for large Swiss banks at USD 50bn during the post-GFC period (2011–2012) based on the CDS approach, and between USD 5 and 20bn using the credit rating approach.[50]

[45] See, for example, Acharya et al. (2022).

[46] See https://www.bis.org/frame/tbtf/impact-estimates.htm?m=247.

[47] The authors also highlight the ambiguity of TBTF indicators during calm periods, noting that low indicator values can reflect either a low likelihood of government support or of financial distress. For more recent estimates of TBTF premia in the USA, see Berndt et al. (2025).

[48] See their Figure 3.8. Lambert et al. (2014) include in their sample all global systemically important banks plus the three largest banks by asset size in each country.

[49] See their Figure 3.10. For banks just below investment grade, the authors report that the subsidy rises to around 70–75bps during times of market calm.

[50] See their pp. 114, 118.

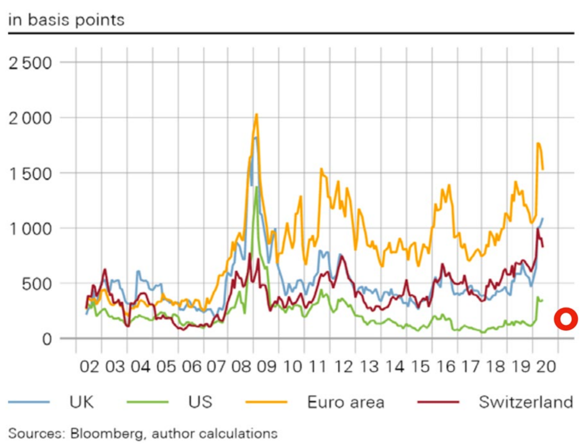

Fig. 3 Allenspach et al. (2021, p. 15): TBTF subsidy rate for Swiss banks in international comparison (bps). We have added a red circle at the bottom right of the figure indicating our own estimate for UBS

Ueda and Weder di Mauro (2013) find that anticipated government support boosts the ratings of systemically important Swiss banks by 2.6–3.2 notches (out of 15) in 2007 and by 3.1–3.9 notches in 2009. Drawing on the conversion from Soussa (2000), which indicates that a three-notch improvement in the rating of five-year bonds corresponds to a funding cost reduction of 5–128bps for banks rated between A and B, the estimates by Ueda and Weder di Mauro (2013) imply funding cost reductions of 4–137bps in 2007 and 5–166bps in 2009.

Schich et al. (2014) calculate banks' funding cost reduction due to implicit TBTF guarantees as the product of three factors: the 'uplift' (the difference between the credit rating with and without guarantees), the strength of the uplift's effect on the interest rate the bank has to pay, and the amount of rating-sensitive debt issued by the bank. They find particularly high funding cost reductions in countries with large banking sectors. For Switzerland, they estimate a funding cost reduction of just over 0.6% of GDP in 2012 and 2013.[51] Figure 7 in the Appendix illustrates the time series of the estimated funding cost reduction for Swiss banks.

Zhao (2018) examines CDS spreads for senior and junior debt to infer implicit government guarantees. For 2007, the study identifies implicit subsidy rates of 220bps for Credit Suisse and 195bps for UBS. During quieter periods, Zhao (2018) finds significantly smaller subsidy rates of approximately 1bp.[52]

Finally, it is instructive to consider the profit shares that Swiss cantonal banks distribute to their owners.[53] In 2017, cantonal banks distributed approximately 4.5% of profits before tax as compensation for cantonal guarantees.[54] Zürcher Kantonalbank, the only SIB with an explicit state guarantee, distributed on average 2.7% of pre-tax profits to compensate the canton of Zurich for the state guarantee in the years 2017–2022.[55]

To summarize these results from the literature, estimated TBTF subsidy rates exhibit significant co-variation with prevailing conditions in financial markets. During "quiet" periods, subsidy rates are typically in the single digit or low double-digit basis points, whereas in times of financial stress, they can surge to several percentage points. Our estimates for UBS senior debt in 2022 fall within the range of estimates documented in the literature. The methodology from Finkelstein et al. (2002) yields a subsidy rate of 5.74%, while our preferred calibration—which distinguishes between senior debt and total loss-absorbing capacity—yields a subsidy rate of at least 1.6% and a total subsidy (excluding deposits) of USD 2.9bn.

These estimates are lower than the subsidy rates reported by Allenspach et al. (2021), who find an average of 400bps for Swiss SIBs during 2008–2018, and by Zhao (2018), who estimate 220bps and 195bps for Credit Suisse and UBS in 2007. Our preferred estimate of at least 1.6% is also consistent with the mid-range estimates from Lambert et al. (2014), who report subsidy rates of approximately 175bps in 2013 for Swiss SIBs using CDS spreads. While prevailing market conditions may have been relatively smooth in 2022 for UBS, the turmoils at Credit Suisse that failed in March 2023 may have had some spillovers on UBS already in 2022. Finally, while our analysis focuses specifically on UBS as a Swiss global SIB, the magnitudes we observe align well with prior work on TBTF subsidies for systemically important financial institutions in Switzerland.

[51] See their p. 16. The authors include the following Swiss banks in their sample: Bank Julius Baer & Co. Ltd, Banque Cantonale Vaudoise, Clariden Leu AG, Credit Suisse AG, Raiffeisen Schweiz Genossenschaft, St. Galler Kantonalbank, UBS AG, Valiant Bank AG, Zürcher Kantonalbank.

[52] See p. 96 in Zhao (2018).

[53] Arguably, cantonal banks generate additional "dividends" for their owners by providing mandated services, e.g., to local businesses. Even without explicit state guarantees, market participants anticipate government support for cantonal banks in times of crisis. See, for example, Moody's October 2024 rating of Berner Kantonalbank AG (https://www.bekb.ch/-/media/bekb/portal/documents/news/rating_action-moodys-ratings-affirms-berner-20241004.pdf): "The affirmation of BEKB's ratings follows the affirmation of the bank's a2 BCA and a1 Adjusted BCA, the latter incorporating our unchanged assumption of a high affiliate support from its majority owner, the Canton of Berne, resulting in one notch of rating uplift for the bank's Adjusted BCA".

[54] See pp. 40 in https://www.bak-economics.com/fileadmin/documents/reports/BAK_Economics_Volkswirtschaftliche_Bedeutung_Kantonalbanken.pdf.

[55] See p. 68 of the Dispatch.

5 Conclusion

We have examined the rationale for a Swiss PLB and its fee structure, and argued that corrective measures are essential to align the incentives of SIB managers and shareholders with societal interests. The ex post terms and conditions attached to SNB liquidity support and a PLB are not very effective for this purpose, not least because they have limited relevance for initial shareholders and management and because their impact may be overshadowed by the implicit subsidy of non-convertible debt that arises from the expectation of crisis support measures. We have also argued that the presence of SIBs calls for increased precautionary savings, as the potential for their failure introduces uncertainty and significant downside risks for government finances and the broader economy.

Finally, we have estimated the implicit subsidy for UBS resulting from its status as a TBTF SIB and compared our estimate with other estimates in the literature. According to our analysis, UBS's funding cost advantage amounts to a subsidy rate of at least 1.6% on its senior debt, equating to a total TBTF subsidy of at least USD 2.9bn, which compares with 2022 net profits of UBS of USD 7.2bn. We argue that bank regulation should address the overall TBTF subsidy holistically, rather than attempting to correct the PLB-related component in isolation.

We conclude with four qualifications. First, our work highlights the substantial uncertainty about TBTF subsidies given the limited amount of granular balance sheet data. We have tried to address this limitation by making conservative assumptions.

Second, the TBTF subsidy we focus on is only one part of the broader spectrum of explicit and implicit subsidies that banks receive. Most notably, banks benefit from a liquidity premium on instruments like deposits, which lowers their financing costs. This premium arises partly from the central bank's role as lender of last resort, both in times of crisis and during normal periods, and is thus, in part, a subsidy.

Third, the economic costs of government interventions to support financial institutions can be larger or smaller than the subsidy we have identified, depending on factors such as elasticities and other market frictions. Accordingly, our findings do not necessarily call for corrective taxes of a similar magnitude.

Finally, government measures to counteract distortions need not be limited to taxes or fees. Quantity restrictions and other regulatory tools can have similar corrective effects. Given the large sums at stake, SIBs are likely to resist such measures, regardless of their form.

Appendix

Additional tables

Table 3 Standard calibration

	Value or range	Source
σ_S	[0.3226, 0.3399]	Extrema of 300-, 600-, and 900-day averages of UBS stock price growth (annualized), Refinitiv data
λ	0.3000	Finkelstein et al. (2002)
$\bar{L}$	0.5240	Schweikhard and Tsesmelidakis (2012), Table III A, Fin, post-crisis period
$\frac{E}{E+\bar{L}D}$	0.0944	2022 UBS annual report
r	0.4858%	2022 average risk-free rate on 5-year Swiss Confederation bonds, Refinitiv data
R	[0.4800, 0.7700]	Average historical recovery rate Begenau and Landvoigt (2022), optimistic historical average Bennett and Unal (2015)

Additional figures

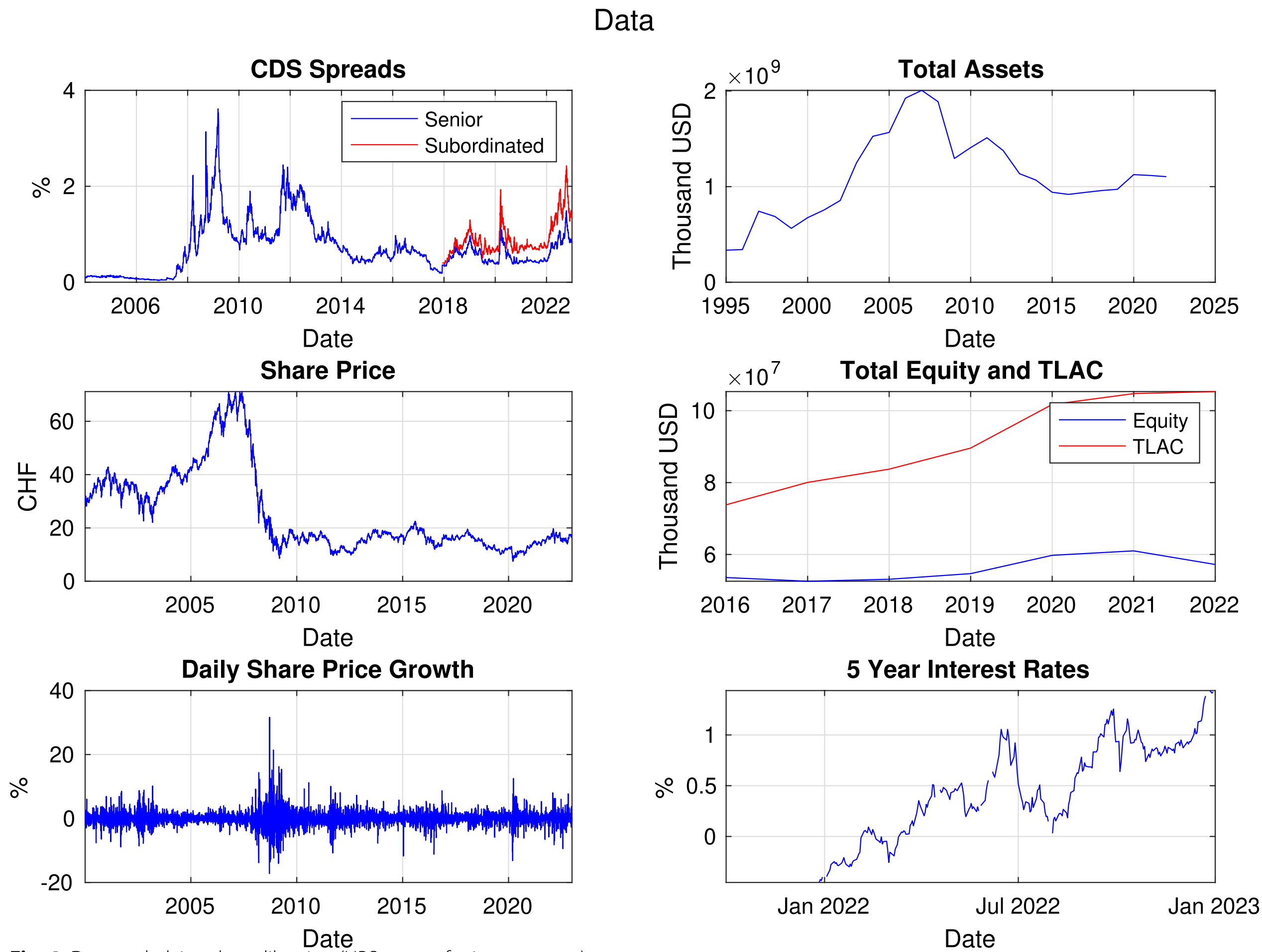

Fig. 4 Data underlying the calibration (UBS except for interest rates)

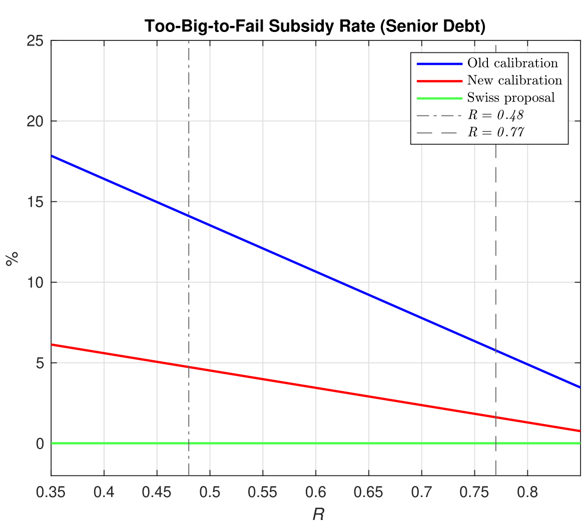

Fig. 5 Estimated TBTF subsidy rate for different recovery rates, *R*

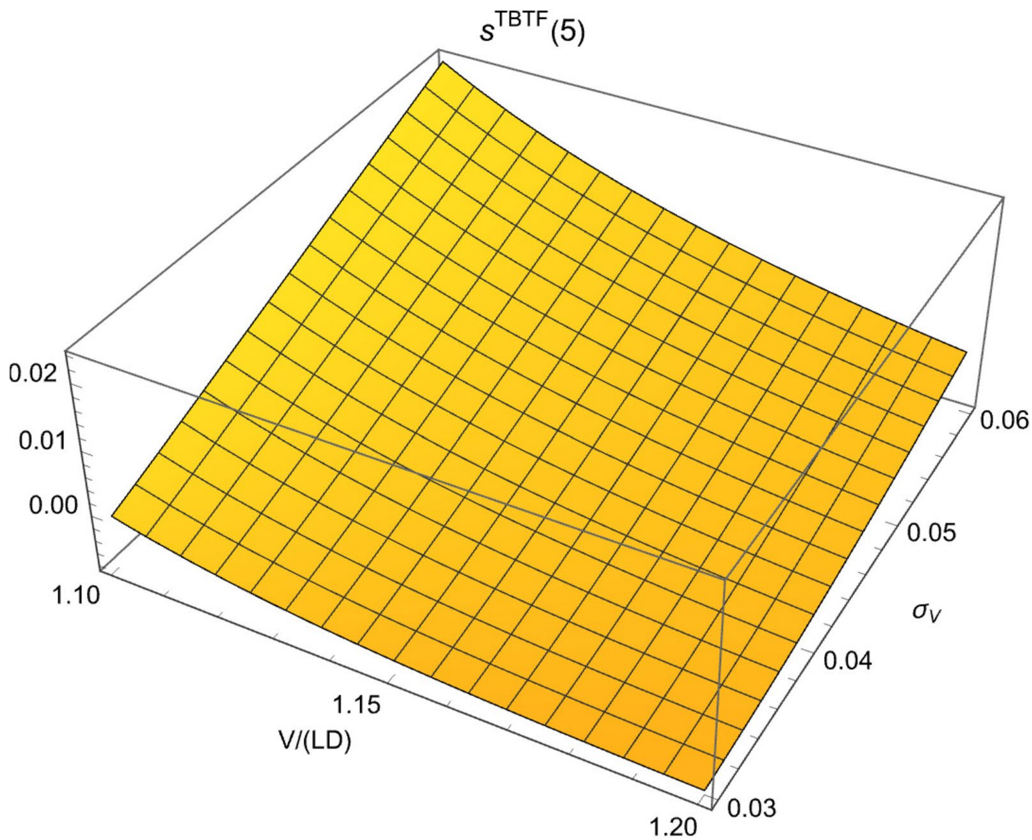

Fig. 6 Estimated TBTF subsidy rate for different TLAC ratios and asset volatilities

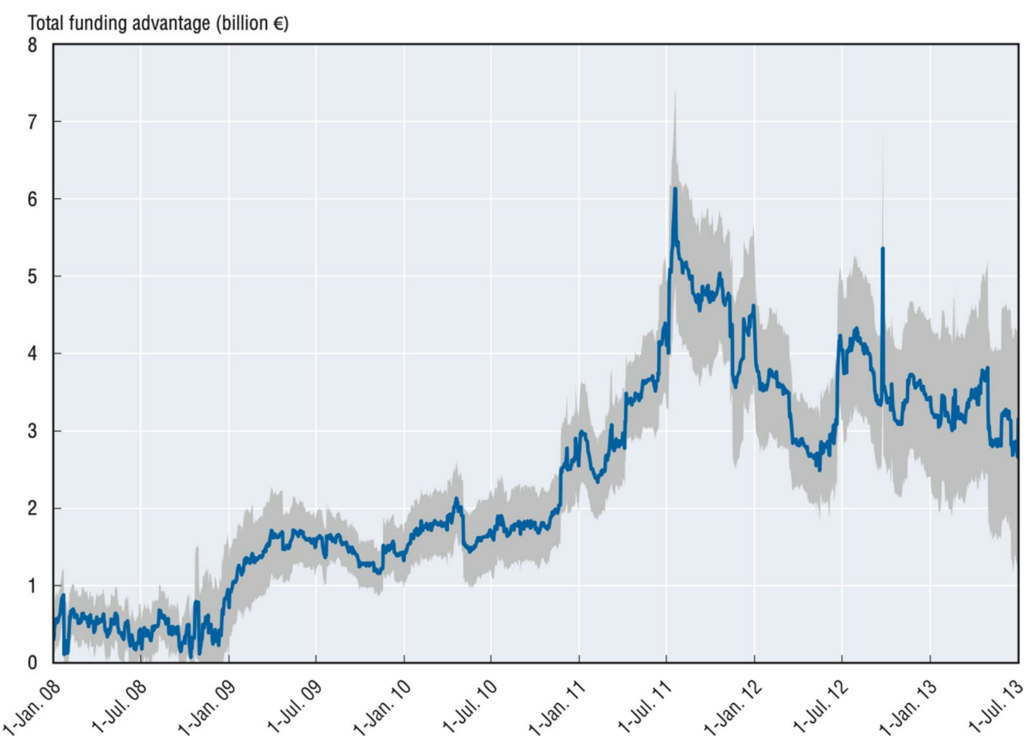

Fig. 7 Schich et al. (2014, p. 29): Funding cost reduction due to implicit TBTF guarantees for Swiss banks (billions of EUR)

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Author contributions
All authors contributed equally

Data availability
No datasets were generated or analyzed during the current study.

Declarations

Conflict of interest
The authors declare no conflict of interest.

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