Loan Guarantees in a Democracy*

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Abstract

We study the political economy of loan guarantees within a credit-rationing framework. In this framework, a government uses guarantees to decrease the borrowing cost, thus making more households incentive compatible. This shifts capital to productive projects (allocative effect). Backed by taxpayers, loan guarantees also shift consumption from non-borrowers to borrowers (redistributive effect). While a welfare-maximizing planner is only concerned about the allocative effect, the decision of politicians is driven by both effects. We show that even when the majority is formed by borrowers, who are the beneficiaries of the redistributive effect, the allocative effect reins in the generosity of guarantees.

Keywords: loan guarantees, redistributive effect, allocative effect, voting

JEL Classification: D72, G28

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1 Introduction

Loan guarantees by a government that reimburses the lender in case of a loan failure are entrenched in contemporary economies.[1] The rationale is driven by allocative concerns: Loan guarantees can boost economic activity by facilitating access to credit (Mankiw, 1986; Gale, 1990). This results in a redistribution from the entire society to borrowers, to the extent guarantees are backed by taxpayers' money. But this is merely an unintended consequence from the perspective of a welfare-maximizing benevolent dictator. On the other hand, standard political economic reasoning suggests that in a democracy, where decision-makers are neither benevolent nor dictators, guarantees are offered primarily based on redistributive concerns: Politicians endorse guarantees insofar as a large enough mass of voters will benefit from them.

That is, the mechanism at work when loan guarantees are decided in a democracy is distinct from the one driving a social planner's decision. In this paper we formalize a mechanism that drives the decision of office-motivated politicians on loan guarantees, and we compare it to the welfare-maximizing solution. We show that allocative concerns, which make a social planner offer guarantees in the first place, rein in the generosity of guarantees when decided in a democracy; even when the beneficiaries of guarantees form the majority.

This mechanism arises in a textbook credit-rationing model (Tirole, Chapter 3, (2006)), which we augment with a government that sets the fraction of loan principal that will be returned to a lender institution in case of a failure. The government is run by the winner of an election. After the policy on loan guarantees is announced by the winner, households (which voted during the election) apply for a loan to implement a productive project. We refer to households that obtain financing as borrowers, and to households

[1]For example, according to the Congressional Budget Office in the US, the federal government is projected to provide loan guarantees of $1.3 trillion within 2024 (https://www.cbo.gov/system/files/2023-08/59232-federal-credit-programs.pdf).

that do not obtain financing as non-borrowers. Households are subject to moral hazard in that, after obtaining a loan, they can choose low effort and extract a private benefit. Households are heterogeneous as to their private benefit.

In this setup, we delineate two effects of loan guarantees. The redistributive effect pertains to the shift of resources from the rest of the economy to borrowers. This happens because loan guarantees (which decrease the borrowing cost) are funded by lump-sum taxation. The allocative effect pertains to the observation that loan guarantees allow more capital to be allocated to productive projects. This happens because a lower borrowing cost means higher borrower income in case of success. This, in turn, makes more households incentive compatible, thus alleviating credit-rationing.

A welfare-maximizing planner is only concerned about the allocative effect. On the contrary, office-motivated politicians are driven by both effects in that their decision determines (i) the extent to which borrowers benefit from redistribution, and (ii) the classification of households-voters between borrowers and non-borrowers. Indeed, politicians offer guarantees on the condition that a large share of the electorate benefits from the redistributive effect. But as guarantees increase, the seeds of redistribution are shared among a larger base due to the allocative effect. This makes the beneficiaries of redistribution to demand less generous guarantees. That is, the allocative effect, which drives the economic rationale for a welfare-maximizing planner to offer loan guarantees, is the balancing force that constrains the generosity of guarantees in a democracy.

The role of the allocative effect in reining in the generosity of guarantees in a democracy is sustained in two polar opposite political environments: When loan guarantees is the sole issue during an electoral campaign (e.g., because of a recession), and when the salience of loan guarantees vis-à-vis other (unrelated) issues is small enough. It also persists when guarantees determine the type of project that is implemented by a household, in a setup where households secure financing with certainty. We show, however, that both the redistributive and the allocative effects disappear once the financial constraint becomes slack. Nonetheless, there is a threshold level of guarantees below which the financial constraint remains tight. As long as this is the case, the interaction between the redistributive and the allocative effect determines the decision of office-motivated politicians on loan guarantees.

Related literature. Our work relates to the literature on the role of loan guarantees in alleviating credit-rationing, spanning from Mankiw (1986) and Gale (1990) to Tirole (2012) and Philippon and Skreta (2012) to Ahnert and Kuncl (2023), among others. Our paper features the standard allocative effect of guarantees (that alleviates credit-rationing), and introduces the redistributive effect as a distinct determinant of the design of loan guarantees. This is the result of adopting a political economic perspective in which loan guarantees are designed by office-motivated politicians in a democracy, rather than by a welfare-maximizing planner.

Our work also relates to theoretical studies on how voting shapes financial regulation (such as debt moratorium (Bolton and Rosenthal, 2002), corporate governance rules (Biais and Perotti, 2002; Pagano and Volpin, 2005; Perotti and von Thadden, 2006), macro-prudential regulation (Rola-Janicka, 2021), and bailouts (Schilling, 2021)), or corporate decisions (Levit et al., 2024). Studying loan guarantees, our work complements the above articles in terms of the substance of financial regulation that is decided via voting.

In terms of modeling, our paper follows Pagano and Volpin (2005), Schilling (2021), and Levit et al. (2024) in that voters are endogenously classified into groups with inherently distinct preferences. Pagano and Volpin (2005) consider a setup where financing and labor contracts determine the segmentation of the electorate. In Schilling (2021), the classification of voters between depositors and non-depositors is driven by banks' strategic decision that allows them to elicit a favorable bailout policy. Levit et al. (2024) consider voting where short-termist and long-termist shareholders have different preferences; the mass of these groups is determined endogenously as a result of trading. In all three cases, the mass of different groups, albeit endogenous, is fixed before voting.

The novelty in our paper is that households-voters are classified into different groups *after* the election. This means that when casting their vote, households account (i) for the redistribution from non-borrowers to borrowers as a result of loan guarantees, and (ii) for that guarantees will determine whether they are borrowers or non-borrowers. This leads to uncovering the role of the allocative effect (which is the economic justification of guarantees in the first place) in constraining the generosity of guarantees in a democracy where politicians are primarily driven by the redistributive effect. Moreover, this ex post classification of households-voters generates a non-trivial voting problem with non-single-peaked and discontinuous payoffs.

We proceed as follows. In Section 2 we describe the model, and we solve it in Section 3. In Section 4 we extent the baseline analysis, and we conclude in Section 5. All proofs are given in the Appendix.

2 Model

We consider a society where households act both as economic agents and as voters. We thus describe in turn the economic and political stage under consideration.

2.1 Economic Stage

There is a continuum of risk-neutral households of mass one.[2] Let $i \in [0, 1]$ denote an individual household. There also is an endowment of one capital unit that is uniformly distributed over lender institutions which operate under perfect competition. A household applies for a loan in order to finance a fixed scale project. Financing all households'

[2]Risk neutrality is standard (see, for example, Mankiw (1986) and Ahnert and Kuncl (2023), among others) to abstract from the role of guarantees in risk-sharing.

projects requires exactly one capital unit. We refer to a household that obtains financing as a borrower, and to a household that fails to do so as a non-borrower. Let ι and $1-\iota$ denote the mass of borrowers and non-borrowers, respectively.

After financing, a borrower decides whether to exert low or high effort. If a borrower exerts low effort, the project fails with certainty and returns nothing, yet the borrower receives a private benefit. Let $b_i \sim \mathcal{U}(0,1)$ denote the private benefit per scale unit that uniquely characterizes household $i \in [0,1]$. Abusing notation, we consider that households are ranked so that $b_i \equiv i$. In line with Tirole, Chapter 3 (2006), we interpret the private benefit b_i as the "fun", or the "perks", or "spinoff opportunities", or the "glamor" that household i enjoys by this choice. Heterogeneity with respect to the private benefit means that different individuals attach different values to the above. If a borrower exerts high effort, the project succeeds with probability p, in which case it returns R output units per scale unit, or fails with probability $1-p$ in which case it returns nothing. High effort entails no private benefit.

Borrowers are protected by limited liability in case of failure. Let r_l and r_b, with $R = r_l + r_b$, denote the per unit returns that go to the lender institution and to the borrower, respectively, if the project turns out to be successful. There also exists a government that pays lenders the fraction $\phi \in [0,1]$ of the loan principal in case of a failure. Compensating one unit of loan principal costs $1+\kappa$ units, where κ represents the administrative cost of guarantees. The entire cost of guarantees is distributed evenly across all households.

Note that all returns are per unit, and the total endowment of one capital unit would be required to finance all households' projects. Therefore, the payoff of household i reads

$$\nu_i = \begin{cases} -(1-p)(1+\kappa)\iota\phi & \text{if } i \text{ is a non-borrower} \\ b_i - (1-p)(1+\kappa)\iota\phi & \text{if } i \text{ is a low-effort borrower} \\ pr_b - (1-p)(1+\kappa)\iota\phi & \text{if } i \text{ is a high-effort borrower.} \end{cases} \tag{1}$$

We assume the following:

Assumption 1. $R \in (1/p, 2/p)$.

Assumption 2. $0 \leq \kappa \leq \min\{(pR-1)/(2-pR), (2-pR)/(pR-1)\}$.

The bottom bound in Assumption 1 implies that obtaining financing has a positive net present value, which justifies a government intervention in the form of loan guarantees that will turn out to alleviate the financial constraint of moral hazard. The upper bound in Assumption 1 rules out trivial solutions where every household would obtain financing regardless of the chosen policy (which would make moral hazard irrelevant). Assumption 2 sets an upper bound for the administrative cost of guarantees. This ensures that guarantees can be beneficial, at least for households with small b_i. This assumption allows the characterization of the political equilibrium in a closed form. Assumptions 1 and 2 are relaxed in extensions in Section 4.

2.2 Political Stage

Guarantees are determined as a result of an electoral competition which, as shown in Figure 1, takes place before the allocation of capital. In the tradition of Downs (1957), there are two candidates (a and b), the electorate is composed of all households, each household-voter has exactly one vote, and all information is publicly known. This means that there is no uncertainty about voters' preferences, and hence candidates can anticipate the election result when proposing their platforms. Candidates are non-ideological, and

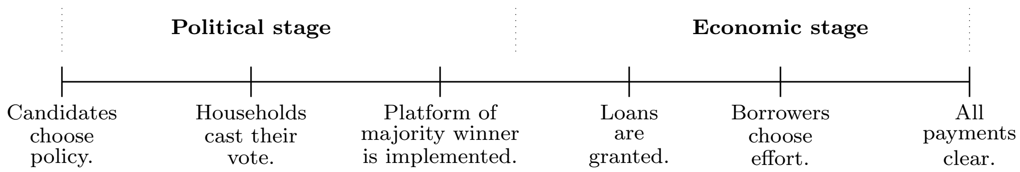


Figure 1: Timeline

aim at maximizing their vote shares. In what follows we describe this standard political game.

The two candidates compete by simultaneously choosing platforms in the policy space. Let $\phi_j \in [0,1]$ denote the platform of candidate $j \in \{a,b\}$. Then, households vote for the candidate whose platform, if elected, would maximize their payoff.[3] That is, household i votes for a if $u_i(\phi_a) > u_i(\phi_b)$, and votes for b if $u_i(\phi_a) < u_i(\phi_b)$. If $u_i(\phi_a) = u_i(\phi_b)$, then household i votes for each candidate with probability 1/2. Finally, the vote shares of the two candidates ($v_a, v_b \in [0,1]$ with $v_a = 1 - v_b$) are announced, and the platform of the majority winner is implemented. Hence, ϕ_a is the implemented policy if $v_a > v_b$, ϕ_b is the implemented policy if $v_b > v_a$, and ϕ_a and ϕ_b are implemented each with probability 1/2 if $v_a = v_b$.

3 Analysis

We solve backward. We thus begin with the financing decisions. A lender institution receives $pr_l + (1-p)\phi$ from granting a loan to a borrower who exerts high effort, whereas it receives ϕ with certainty when granting a loan to a borrower who chooses low effort. A borrower, i.e., a household that obtained financing, exerts high effort if the incentive compatibility constraint

$$pr_b = p \cdot (R - r_l) \geq b_i \tag{2}$$

[3]We adopt the standard assumptions that (i) refraining from voting is not an option, and (ii) households vote sincerely for their preferred policy. For detailed discussions see Riker and Ordeshook (1973), among many others.

is satisfied. Otherwise, a borrower exerts low effort.

When $\phi = 1$, a lender institution breaks even with certainty if the borrower exerts low effort. In this case, perfect competition among lenders results in $r_l = 0$, which means that the incentive compatibility constraint reads $pR \geq b_i$, which (because of Assumption 1) is satisfied for every $b_i \in [0, 1]$. That is, $\phi = 1$ and low effort cannot occur simultaneously. When $\phi \in [0, 1)$, a lender receives $\phi < 1$ if a borrower exerts low effort, which implies a loss. Hence, a loan is granted if and only if the incentive compatibility constraint is satisfied.[4]

Because perfect competition dictates no profits for lender institutions, it holds that

$$pr_l + (1 - p)\phi = 1. \tag{3}$$

This means that $r_l = (1 - (1 - p)\phi)/p$, and $r_b = R - (1 - (1 - p)\phi)/p$. Namely, loan guarantees decrease the borrowing cost, or equivalently, raise a borrower's income in case of success. The incentive compatibility constraint as given by (2) is then satisfied for every

$$b_i \leq pR - 1 + (1 - p)\phi. \tag{4}$$

Because every household i in the mass $[0, 1]$ is uniquely characterized by $b_i \sim \mathcal{U}(0, 1)$, and making the (otherwise inconsequential) assumption that a household chooses to be a high-effort borrower in case of indifference, we obtain from (4) that the mass of borrowers reads

$$\iota(\phi) = \min\{1, pR - 1 + (1 - p)\phi\}. \tag{5}$$

The higher the ϕ, the larger (smaller) the mass of borrowers (non-borrowers).[5]

[4]Since financing a low effort borrower is not a solution, moral hazard is reflected in equilibrium only into whether a household obtains financing, as in Tirole, Chapter 3 (2006). In an extension in Subsection 4.3, we study an alternative setup where a household obtains financing with certainty, and the question at hand is the type of project a household chooses.

[5]If $\phi \geq (2 - pR)/(1 - p)$, then even the household with $b_1 = 1$ obtains financing, and therefore $\iota = 1$.

Taking into account that a loan is granted if and only if the incentive compatibility constraint is satisfied, we re-write the payoff of household i, defined by (1), as

$$\nu_i = \begin{cases} \nu_i^n \equiv -(1-p)(1+\kappa)\iota(\phi)\phi & \forall b_i > pR - 1 + (1-p)\phi \\ \nu_i^b \equiv pR - 1 + (1-p)\phi - (1-p)(1+\kappa)\iota(\phi)\phi & \forall b_i \leq pR - 1 + (1-p)\phi, \end{cases} \tag{6}$$

where $\iota(\phi)$ is given by (5), and ν_i^n and ν_i^b denote the payoff of household i as a non-borrower and as a borrower, respectively.

From (4), we define

$$\bar{\phi}_i \equiv \frac{1 + b_i - pR}{1-p} \tag{7}$$

as the level of guarantees above which household i becomes incentive-compatible. It then holds that

$$\hat{\phi}_i^n \equiv \underset{\phi \in [0,\bar{\phi}_i];\bar{\phi}_i > 0}{\arg\max}\ \nu_i^n = 0; \tag{8}$$

$$\hat{\phi}_i^b \equiv \underset{\phi \in [\max\{0,\bar{\phi}_i\},1];\bar{\phi}_i < 1}{\arg\max}\ \nu_i^b = \min\left\{1, \max\left\{\bar{\phi}_i, \frac{1-(1+\kappa)(pR-1)}{2(1+\kappa)(1-p)}\right\}\right\}. \tag{9}$$

The level of guarantees maximizing the payoff of household i as a non-borrower, i.e., $\hat{\phi}_i^n$, and as a borrower, i.e., $\hat{\phi}_i^b$, is driven by the redistributive and the allocative effects of guarantees, which we delineate below.

The redistributive effect becomes apparent by (6): A household that satisfies the incentive compatibility constraint receives $(1-p)\phi$ as a result of guarantees decreasing the borrowing cost; a household that does not satisfy the incentive compatitibility constraint receives (as a non-borrower) nothing from guarantees. At the same time, all households (i.e., borrowers and non-borrowers) pay $(1-p)(1+\kappa)\iota(\phi)\phi$ as taxpayers. That is, guarantees cause a redistribution from non-borrowers to borrowers.

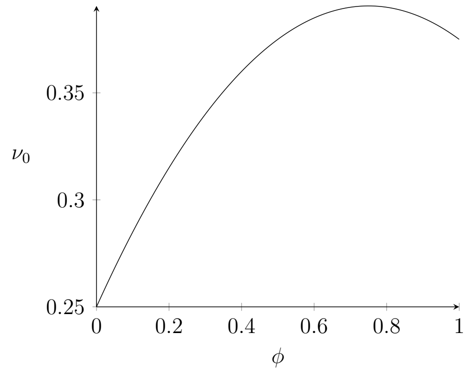
It follows from Assumption 1 that $0 < \iota(0) < 1$.

The allocative effect refers to the role of loan guarantees in alleviating the financial friction of moral hazard, thus allowing more capital to be allocated to a productive project. We distinguish between the allocative classification-effect, and the allocative size-effect, which are two represantations of the same effect. The allocative classification-effect refers to the observation that a household can be classified as a borrower for sufficiently large values of ϕ, but remains a non-borrower otherwise (as shown by (4), or, equivalently, by (7)). The allocative size-effect refers to the increasing mass of borrowers with respect to ϕ, as shown by (5).

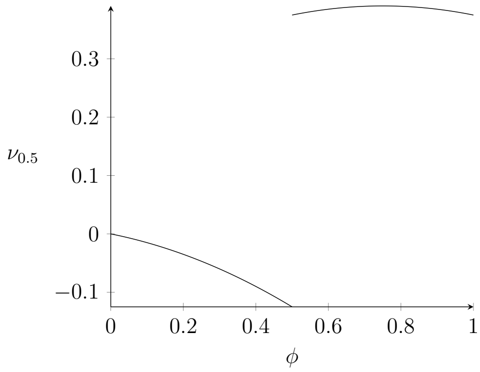
The allocative size-effect impacts all households in the same way: The aggregate cost of guarantees increases as the mass of beneficiaries increases. The allocative classification-effect determines whether the redistributive effect harms or benefits a household. As long as a household is a non-borrower, the redistributive effect harms its payoff, and the harm becomes larger as the allocative size-effect becomes stronger due to larger guarantees. Namely, the allocative size-effect and the redistributive effect work in the same direction as long as a household is a non-borrower. But they work in opposite directions when it comes to a household that is a borrower. Such a household aims to boost the guarantees-driven redistribution from non-borrowers to borrowers, while containing the harm due to the allocative size-effect of guarantees.

Households with a large private benefit, namely, with b_i above $\iota(1)$, are non-borrowers for every $\phi \in [0, 1]$, and have thus single-peaked preferences, with a maximum at $\phi = 0$ (see, for example, Figure 2d). Households with a small private benefit, namely, with b_i below $\iota(0)$, are borrowers for every $\phi \in [0, 1]$, and have thus single-peaked preferences with a maximum at $\phi = \min\{1, (1 - (1 + \kappa)(pR - 1))/(2(1 + \kappa)(1 - p))\}$ as known from (9) (see, for example, Figure 2a).

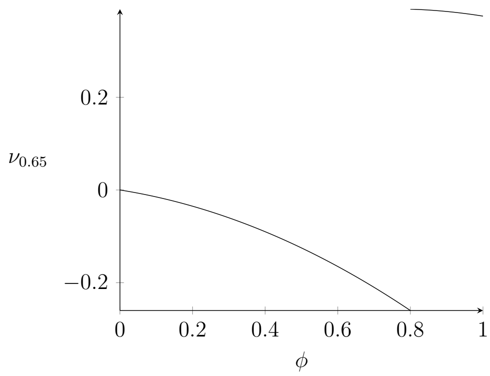
However, the distinct values that maximize a borrower's and a non-borrower's payoff, along with the allocative classification-effect that can make a household non-borrower



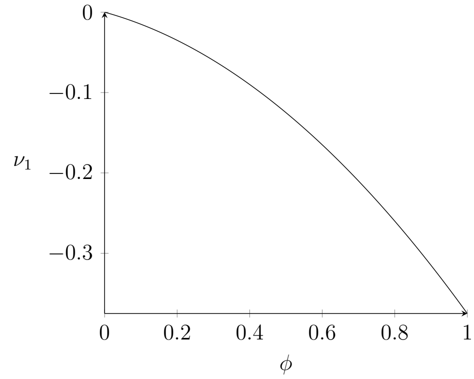
(a) Household 0, which is a borrower for every $\phi \in [0, 1]$, maximizes its payoff at $\phi = 0.75$.



(b) Household 0.5, which is a borrower for every $\phi \in [0.5, 1]$, maximizes its payoff at $\phi = 0.75$.



(c) Household 0.65, which is a borrower for every $\phi \in [0.8, 1]$, maximizes its payoff at $\phi = 0.8$.



(d) Household 1, which is a non-borrower for every $\phi \in [0, 1]$, maximizes its payoff at $\phi = 0$.

Figure 2: $u_i(\phi)$ of different households when $p = 0.5$, $R = 2.5$ and $\kappa = 0$

for small ϕ and a borrower when ϕ exceeds $\bar{\phi}_i$, give rise to non-single-peaked policy preferences for households with intermediate values of private benefit, namely with b_i between $\iota(0)$ and $\iota(1)$ (see, for example, Figures 2b and 2c). These households feature $\hat{\phi}_i^n < \bar{\phi}_i < 1$, and have two local maxima, one when the household is a non-borrower and one when it is a borrower. Moreover, the payoff of these households is discontinuous at $\phi = \bar{\phi}_i$. This makes the characterization of the political equilibrium non-trivial.[6]

Let $\mathcal{G}$ denote the game between the two vote-share-maximizing candidates who simultaneously choose ϕ_a and ϕ_b, being aware that the payoff of every household $i \in [0, 1]$ is determined by (6). An equilibrium of the game $\mathcal{G}$ refers to a pair (ϕ_a^*, ϕ_b^*) that constitutes

[6]When continuity and single-peaked preferences hold, an equilibrium follows immediately by the median-voter theorem (Downs, 1957).

a pure strategy Nash equilibrium.

Proposition 1. *Game $\mathcal{G}$ admits a unique equilibrium where candidate $j \in \{a, b\}$ sets*

$$\phi_j^* = \phi^* = \min\left\{1, \frac{1-(1+\kappa)(pR-1)}{2(1+\kappa)(1-p)}\right\}. \tag{10}$$

We have thus shown that there is a unique equilibrium despite the lack of well-behaved preferences. In this equilibrium, the mass of households which secure a loan reads

$$\iota(\phi^*) = \frac{1}{2}\cdot\left(pR - \frac{\kappa}{1+\kappa}\right), \tag{11}$$

whereas the rest, i.e., a mass $1-\iota(\phi^*)$, does not secure a loan. Assumption 2, which is relaxed in the next section, ensures that the households that secure a loan at $\phi = \phi^*$ are in the majority (i.e., $\iota(\phi^*) > 1/2$).[7]

This majority, i.e., households with b_i below $\iota(\phi^*)$, maximize their payoff at ϕ^* as the result of the interaction between the redistributive and the allocative size-effect of guarantees. For small values of guarantees, i.e., as long as $\phi < \phi^*$, the redistributive effect dominates a borrower's preferences: A borrower aims to boost the guarantees-driven redistribution from non-borrowers to borrowers. As ϕ increases, the allocative size-effect becomes stronger, and becomes dominant for every $\phi > \phi^*$: As the generosity of guarantees increases, the seeds of redistribution from non-borrowers to borrowers are shared among a larger base, thus making borrowers preferring less generous guarantees in their effort to restrict the mass of beneficiaries. In equilibrium, namely, at $\phi = \phi^*$, the redistributive and the allocative size-effect balance each other out.

Households with b_i between $\iota(0)$ and $\iota(\phi^*)$ become borrowers in equilibrium only

[7] The upper bound of κ (Assumption 2) works in conjunction with the distribution of b_i to ensure that $\iota(\phi^*) > 1/2$. A left-skewed (right-skewed) distribution of b_i would require a stricter (more relaxed) constraint on κ. The condition of $\iota(\phi^*) > 1/2$, and the respective assumptions, become redundant for the equilibrium existence and uniqueness in the extensions of the next section.

because of guarantees (see, for example, Figure 2b). These households' preferences are aligned with the preference of households with b_i below $\iota(0)$ once they become borrowers, i.e., for every ϕ above $\bar{\phi}_i$. Because these households feature $\bar{\phi}_i$ below ϕ^*, they fall into the majority with a global maximum at $\phi = \phi^*$. The alignment with borrower's preferences for ϕ above $\bar{\phi}_i$ also occurs for households with b_i between $\iota(\phi^*)$ and $\iota(1)$ (see, for example, Figure 2c). Yet, these households end up non-borrowers in equilibrium, and have a global maximum at $\phi = \bar{\phi}_i$. The reason is that these households become borrowers for levels of ϕ above ϕ^*. Being in the minority, these households' preference for guarantees above ϕ^* are overlooked by political candidates. We study a setup where these preferences are also taken into account by candidates in an extension.

We proceed to assess welfare implications of the above described political economic equilibrium.

Definition 1. *The socially optimal solution reads* $\phi^{\text{so}} \equiv \arg\max_{\phi \in [0,1]} \{V(\phi) \equiv \int_0^1 u_i(\phi) di\}$, *where* $\nu_i(\phi)$ *is given by* (6).

Proposition 2. *It holds that*

$$\phi^{\text{so}} = \min\left\{\frac{(pR-1)(1-\kappa)}{2(1-p)\kappa}, \frac{2-pR}{1-p}, 1\right\}. \tag{12}$$

Therefore, $\iota(\phi^*) - \iota(\phi^{\text{so}}) \leq 0$.

A benevolent social planner trades-off the gains from alleviating the financial friction of moral hazard against the cost of guarantees. That is, the social planner is only concerned with the allocative effect. The redistributive effect is only a consequence of the planner's solution. Absent the cost of guarantees, this solution would take the corner value of fully guaranteeing the loan principal (or, guaranteeing up to the level that makes every household a borrower).

The problem of an office-motivated political candidate, solved in Proposition 1, differs.

First, the redistributive effect is taken into consideration by political candidates. Second, the administrative cost of guarantees is not the main driver of the force that pushes loan guarantees downward. In fact, even with $\kappa = 0$, candidates would still choose an internal solution because of the interaction between the redistributive and the allocative size-effect of guarantees: The downward force in a democracy arises because the seeds of redistribution are shared among a larger base as the allocative size-effect increases; not simply because guarantees are costly. Third, as stated above, office-motivated political candidates ignore households which end up non-borrowers, but would prefer larger guarantees to become borrowers. As a result, democracy generates a sub-optimally small level of guarantees when elections take place over the policy issue of loan guarantees.

4 Extensions

We extend the baseline analysis in three dimensions. First, we consider an electoral competition where households-voters take into account both the policy on loan guarantees as well as their political biases. Second, we allow for a competitive market for capital. Third, we consider a setup where all households obtain financing, and the question at hand is the type of project that is implemented by each household.

4.1 Probabilistic Voting

We consider the same economic stage as in the baseline model, only now relaxing Assumption 2 as follows:

Assumption 2′. $\kappa \geq 0$.

Moreover, we introduce probabilistic voting in the political stage in the tradition of

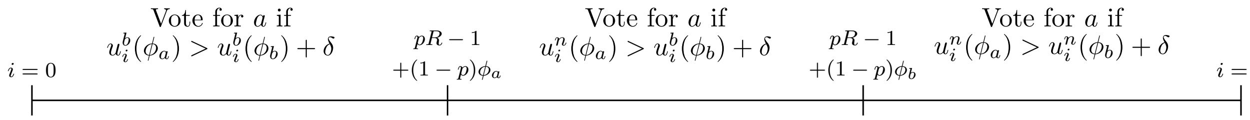


Figure 3: Electorate segmentation when $0 < \phi_a < \phi_b < \min\{\bar{\phi}_1, 1\}$

Lindbeck and Weibull (1987). In particular, household i receives

$$u_i = \begin{cases} \nu_i(\phi_a) & \text{if a wins} \\ \nu_i(\phi_b) + \delta & \text{if b wins,} \end{cases} \tag{13}$$

where ν_i is given by (6), and $\delta \in \mathcal{U}(-1/(2\psi), 1/(2\psi))$, represents households' political bias in favor or against candidate b. Since a larger ψ means that the policy about loan guarantees is more likely to impact a household's utility, we refer to ψ as the political salience of loan guarantees. We work with the standard assumption in probabilistic voting that ψ is small enough so that every household has a chance to vote for either candidate.

To illustrate the voting mechanism at work let us focus on the case where $0 < \phi_a < \phi_b < \min\{\bar{\phi}_1, 1\}$ (see Figure 3). Households with b_i less than $pR-1+(1-p)\phi_a$, i.e., a mass equal to $\iota(\phi_a)$, are incentive-compatible regardless of the winner of the election, and each of them votes for candidate a with probability $\frac{1}{2} + \psi \cdot (u_i^b(\phi_a) - u_i^b(\phi_b))$. Households with b_i above $pR - 1 + (1-p)\phi_b$, i.e., a mass equal to $1 - \iota(\phi_b)$, are non-incentive-compatible regardless of the winner of the election, and each of them votes for candidate a with probability $\frac{1}{2} + \psi \cdot (u_i^n(\phi_a) - u_i^n(\phi_b))$. Finally, households with b_i between $pR-1+(1-p)\phi_a$ and $pR - 1 + (1-p)\phi_b$, i.e., a mass equal to $(1-p) \cdot (\phi_b - \phi_a)$, are incentive-compatible only if candidate b wins and are otherwise non-incentive-compatible, and each of them votes for candidate a with probability $\frac{1}{2} + \psi \cdot (u_i^n(\phi_a) - u_i^b(\phi_b))$.

Let $\tilde{\mathcal{G}}$ denote the game between the two vote-share-maximizing candidates who simultaneously choose $\tilde{\phi}_a$ and $\tilde{\phi}_b$, being aware that the utility of every household $i \in [0, 1]$ is determined by (13). An equilibrium of the game $\tilde{\mathcal{G}}$ refers to a pair $(\tilde{\phi}_a^*, \tilde{\phi}_b^*)$ that constitutes a pure strategy Nash equilibrium.

Proposition 3. *Game $\tilde{\mathcal{G}}$ admits a unique equilibrium where candidate $j \in \{a, b\}$ sets*

$$\tilde{\phi}_j^* = \tilde{\phi}^* = \max\left\{0, \min\left\{\frac{(pR-1)(1-\kappa)}{2(1-p)\kappa}, \frac{2-pR}{1-p}, 1\right\}\right\}. \tag{14}$$

To explain the intuition, we re-write the first derivative of the vote share of candidate a with respect to ϕ_a, which is given in the proof of Proposition 3 in the Appendix, as

$$\begin{aligned}\frac{\partial v_a}{\partial \phi_a} =& \psi \frac{\partial u_i^b(\phi_a)}{\partial \phi_a} \cdot (pR - 1 + (1-p)\phi_a) \\ &+ \psi \frac{\partial u_i^n(\phi_a)}{\partial \phi_a} \cdot (2 - pR - (1-p)\phi_a) \\ &+ \psi(1-p)\left(u_i^b(\phi_a) - u_i^n(\phi_a)\right),\end{aligned} \tag{15}$$

for every $0 < \phi_a < \phi_b < \min\{\bar{\phi}_1, 1\}$. The first line pertains to the preferences of borrowers, which are driven by the interaction between the redistributive and the allocative size-effect: They benefit from guarantees' redistribution, but they are cautious as to the generosity of guarantees because the larger the ϕ, the larger the base of beneficiaries among which the seeds of redistribution are shared. The term in the second line pertains to the preferences of non-borrowers who aim at eliminating the redistribution from non-borrowers to borrowers. The term in the third line, which is positive, pertains to the preference of households that can become borrowers should loan guarantees become large enough.

Political candidates in game $\mathcal{G}$ only take into account the effects that correspond to the term in the first line. This maximizes the payoffs of households that form the majority in game $\mathcal{G}$ under Assumption 2. On the contrary, political candidates in $\tilde{\mathcal{G}}$ need to take all households' preferences into account since there is chance for every household to vote for either candidate under probabilistic voting. This smooths the problem, and makes

Assumption 2 redundant.[8]

Moreover, probabilistic voting shifts the equilibrium solution to the socially optimal level because every household's preferences matter. A prediction follows when interpreting probabilistic voting (game $\tilde{\mathcal{G}}$) as the polar opposite to an electoral competition that takes place over the dimension of loan guarantees (game $\mathcal{G}$). If political discourse has loan guarantees at its center (say due to a recession) as in $\mathcal{G}$, political candidates will focus on the majority's preference. If loan guarantees are formed in a period where other political issues play a role as in $\tilde{\mathcal{G}}$, then candidates' stance will be informed by all households' preferences. In either case, the allocative effect reins in borrowers' and aspirant borrower's support for guarantees.

4.2 Capital Market

We now introduce an alternative destination for capital. We assume that there exists an (otherwise passive) entrepreneur operating a friction-less technology that produces $f(k)$ output units, where k is the amount of capital that is invested in this technology. The production function f satisfies $f' > 0$, $f'' < 0$, $f(0) = 0$, $f'(0) = +\infty$, and $f'(1) = 0$. Profits read

$$f(k) - \rho k, \tag{16}$$

where ρ denotes the per unit returns on k. Profit maximization then requires $\rho = f'(k)$.

This means that a lender institution can either invest in the friction-less technology with per unit returns $\rho = f'(k)$, or finance a household under the financial constraint of moral hazard with per unit returns equal to one. Therefore, any solution needs to satisfy

$$f'(k) \leq 1. \tag{17}$$

[8]Accordingly, in contrast to game $\mathcal{G}$ (see Footnote 7), the skewness of the distribution of b_i is not crucial anymore for the existence and uniqueness of equilibrium in game $\tilde{\mathcal{G}}$.

Let $\check{\iota}$ denote the fraction of capital, as well as the mass of borrowers, satisfying

$$f'(1-\check{\iota}) = 1. \tag{18}$$

We then define

$$\check{\phi} \equiv \frac{1+\check{\iota}-pR}{1-p}. \tag{19}$$

In this setup, $\iota(\phi)$, as given by (5), is the mass of incentive compatible households, but need not be equal to the mass of borrowers. If $\iota(\phi) < \check{\iota}$, then every incentive compatible household becomes a borrower, i.e., $\iota(\phi)$ is also the mass of borrowers. Namely, the incentive compatibility constraint is tight. It then holds that $k(\phi) = 1 - \iota(\phi)$, $\rho = f'(1-\iota(\phi)) < 1$, and ν_i is given by (6). If, however, $\iota(\phi) \geq \check{\iota}$, then lenders only finance a mass $\check{\iota}$, which means that the incentive compatibility constraint is slack. Assuming that every incentive compatible household has the same chance of obtaining financing, a slack constraint means that incentive compatible households become borrowers with probability $\check{\iota}/\iota(\phi)$. In this case, ν_i reads

$$\nu_i = \begin{cases} -(1-p)(1+\kappa)\check{\iota}\phi & \forall b_i > pR - 1 + (1-p)\phi \\ \mathcal{I}\check{\iota} - (1-p)(1+\kappa)\check{\iota}\phi & \forall b_i \leq pR - 1 + (1-p)\phi, \end{cases} \tag{20}$$

where

$$\mathcal{I} \equiv \begin{cases} 1 & \forall \phi < \bar{\phi}_1 \\ pR - 1 + (1-p)\phi & \forall \phi \geq \bar{\phi}_1, \end{cases} \tag{21}$$

because $\iota(\phi) = 1$ for every $\phi \geq \bar{\phi}_1$.

We consider again an electoral competition under probabilistic voting (to avoid parametric assumptions for the existence of an equilibrium). In particular,

$$u_i^c = \begin{cases} \nu_i(\phi_a) & \text{if a wins} \\ \nu_i(\phi_b) + \delta & \text{if b wins,} \end{cases} \tag{22}$$

where ν_i is given by (6) if $\iota(\phi) < \check{\iota}$, and by (20) if $\iota(\phi) \geq \check{\iota}$, and δ is the random parameter that corresponds to household i's political bias as in Subsection 4.1.

Let $\tilde{\mathcal{G}}^c$ denote the game between the two vote-share-maximizing candidates who simultaneously choose $\tilde{\phi}_a^c$ and $\tilde{\phi}_b^c$, being aware that the utility of every household $i \in [0, 1]$ is determined by (22). An equilibrium of the game $\tilde{\mathcal{G}}^c$ refers to a pair $(\tilde{\phi}_a^{c^*}, \tilde{\phi}_b^{c^*})$ that constitutes a pure strategy Nash equilibrium.

Proposition 4. *Game $\tilde{\mathcal{G}}^c$ admits a unique equilibrium where candidate $j \in \{a, b\}$ sets*

$$\tilde{\phi}_j^{c^*} = \tilde{\phi}^{c^*} = \max\left\{0, \min\left\{\check{\phi}, \frac{(pR-1)(1-\kappa)}{2(1-p)\kappa}, \frac{2-pR}{1-p}, 1\right\}\right\}. \tag{23}$$

As long as the financial constraint is tight, candidates' problem is exactly as in the preceding analysis. Once the financial constraint becomes slack, borrowers' individual gains from implementing the project cease to depend on loan guarantees; they are simply determined by the clearing of the capital market. An implication is that the redistributive and the allocative effects disappear once the financial constraint becomes slack. As a result, borrowers' payoff is decreasing in ϕ for every $\phi \geq \check{\phi}$ because of the administrative cost κ.

The crucial question then is whether the financial constraint becomes slack for a value of guarantees that is above or below the value of guarantees that maximizes a candidate's vote share when the constraint is tight. If the constraint becomes slack for values of guarantees where the redistributive effect still dominates households' preferences, then candidates choose $\check{\phi}$, i.e., the highest value of loan guarantees for which the redistributive effect still matters. Otherwise, i.e., if $\check{\phi}$ exceeds $\tilde{\phi}^*$, then candidates choose $\tilde{\phi}^*$ as in game $\tilde{\mathcal{G}}$.

4.3 Continuous Financing

We finally consider a setup where there is no jump as to a household's financing. Rather, every household is financed to implement a project that can be one of two types: safe, or risky. A safe project generates R per unit returns with certainty. A risky project generates R per unit returns with probability $p \in (0, 1)$, and zero with probability $1 - p$. A risky project also generates the private benefit $b_i \sim \mathcal{U}(0, 1)$ for household i. As in the baseline model, we assume that $b_i = i$. To facilitate the interpretation, we disentangle the private benefit from the negative connotation of moral hazard. For example, the private benefit in this setup may refer to gains from running a side-project in the gig economy.

Let η denote the mass of households implementing a safe project, and $\upsilon = 1 - \eta$ the mass of households implementing a risky project. We assume positive externalities $\varepsilon(\upsilon)$ accruing to every household, where $\varepsilon' > 0$, $\varepsilon'' < 0$, $\varepsilon(0) = 0$, $\varepsilon'(0) = +\infty$ and $\varepsilon'(1) = 0$. We interpret $\varepsilon(\upsilon)$ as a measure of innovation, or skills, or entrepreneurship that is spurred in the economy as more households engage with risky projects.[9] This justifies the government to guarantee the repayment of a fraction $\phi \geq 0$ of the loan principal that finances a risky project.[10]

Perfect competition on lenders' side dictates $r_s = R - 1$, where r_s denotes the per unit returns to a household operating a safe project. Moreover, $p(R - r_r) + (1 - p)\phi = 1$, and therefore, $r_r = R - (1 - (1 - p)\phi)/p$, where r_r denotes the per unit returns of a household implementing a risky project.

[9]We work under the assumption that these positive externalities materialize regardless of whether risky projects succeed. It is straightforward to run the analysis assuming that $\varepsilon(\upsilon)$ only materializes with probability p.

[10]Allowing loan guarantees above the full amount of loan principal simplifies the exposition. As opposed to the baseline model where ϕ cannot exceed 100%, a setup where every household obtains financing allows this simplification without further consequences.

Assumption 1′. $R > 1$.

Assumption 2″. $\kappa = 0$.

Assumption 1′ ensures that a safe project has a positive net present value, which in turn sets an upper limit to the socially optimal level of loan guarantees. Assumption 2″ merely simplifies the analysis since it turns out that an internal solution arises even with zero administrative cost (because of Assumption 1′). Note also that Assumption 2″ is not a requirement for the existence of an equilibrium (as opposed to Assumption 2 which is required for the existence of equilibrium in game $\mathcal{G}$). In this setup, an equilibrium would still exist without any restriction on κ, as a result of the continuity of households' payoff.

Household i implements the safe project if

$$R - 1 \geq b_i + pR - 1 + (1-p)\phi. \tag{24}$$

Otherwise, household i undertakes the risky project. Accordingly, we obtain that every household with $b_i \leq (1-p)\cdot(R-\phi)$ implements the safe project, whereas every household with $b_i > \max\{(1-p)\cdot(R-\phi), 1-pR-(1-p)\phi\}$ runs the risky project.[11] We note that $(1-p)\cdot(R-\phi) > 1-pR-(1-p)\phi$ for every $R > 1$, which holds by Assumption 1′. This means that every household obtains financing; the question at hand is whether a household implements the safe or the risky project.

We write

$$\nu_i^{\varepsilon} = \begin{cases} \nu_i^s \equiv R - 1 - (1-p)\upsilon(\phi)\phi + \varepsilon(\upsilon) & \forall b_i \leq (1-p)(R-\phi) \\ \nu_i^r \equiv b_i + pR - 1 + (1-p)\phi(1-\upsilon(\phi)) + \varepsilon(\upsilon) & \forall b_i > (1-p)(R-\phi), \end{cases} \tag{25}$$

[11] The inequality $b_i > 1 - pR - (1-p)\phi$ ensures that a household running the risky project does not exhibit a negative income.

where

$$\upsilon(\phi) = 1 - \eta(\phi) \tag{26}$$

$$\eta(\phi) = \min\{1, \max\{0, (1-p) \cdot (R - \phi)\}\}. \tag{27}$$

Note that we work with the tie-breaking (and otherwise inconsequential) assumption that a household prefers the safe project in case of indifference.

Definition 2. *The socially optimal solution reads* $\hat{\phi}^{\text{so}} \equiv \underset{\phi \in \geq 0}{\arg\max}\{V^{\varepsilon}(\phi) \equiv \int_0^1 u_i^{\varepsilon}(\phi) di\}$, *where* $\nu_i^{\varepsilon}(\phi)$ *is given by* (25).

We consider the political stage as in the baseline model, where electoral competition takes place only over the dimension of loan guarantees. Let $\mathcal{G}^{\varepsilon}$ denote the game between the two vote-share-maximizing candidates who simultaneously choose ϕ_a^{ε} and ϕ_b^{ε}, being aware that the payoff of every household $i \in [0, 1]$ is determined by (25). An equilibrium of the game $\mathcal{G}^{\varepsilon}$ refers to a pair $(\phi_a^{\varepsilon^*}, \phi_b^{\varepsilon^*})$ that constitutes a pure strategy Nash equilibrium.

Proposition 5. *There exist unique* $\hat{\phi}^s$, $\hat{\phi}^{\text{so}}$, *and* $\hat{\phi}^r$ *so that*

$$\varepsilon'(\upsilon(\hat{\phi}^s)) = (1-p) \cdot \Big(2\hat{\phi}^s - R + 1/(1-p)\Big) \tag{28}$$

$$\varepsilon'(\upsilon(\hat{\phi}^{\text{so}}))) = (1-p) \cdot \hat{\phi}^{\text{so}} \tag{29}$$

$$\varepsilon'(\upsilon(\hat{\phi}^r)) = (1-p) \cdot \Big(2\hat{\phi}^r - R\Big), \tag{30}$$

where $\hat{\phi}^s < \hat{\phi}^{\text{so}} < \hat{\phi}^r$. *There also is a threshold*

$$\bar{B} \equiv (1-p) \cdot \Big(R - \hat{\phi}^r(1 - \upsilon(\hat{\phi}^r)) - \hat{\phi}^s \upsilon(\hat{\phi}^s) + \varepsilon(\upsilon(\hat{\phi}^s)) - \varepsilon(\upsilon(\hat{\phi}^r))\Big). \tag{31}$$

Game $\mathcal{G}^{\varepsilon}$ *admits a unique equilibrium where candidate* $j \in \{a, b\}$ *sets* $\phi_j^{\varepsilon^*} = \phi^{\varepsilon^*} = \hat{\phi}^s$, *resulting in* $\upsilon(\phi^{\varepsilon^*}) - \upsilon(\hat{\phi}^{\text{so}}) < 0$, *if* $\bar{B} \geq 1/2$, *whereas sets* $\phi_j^{\varepsilon^*} = \phi^{\varepsilon^*} = \hat{\phi}^r$, *resulting in*

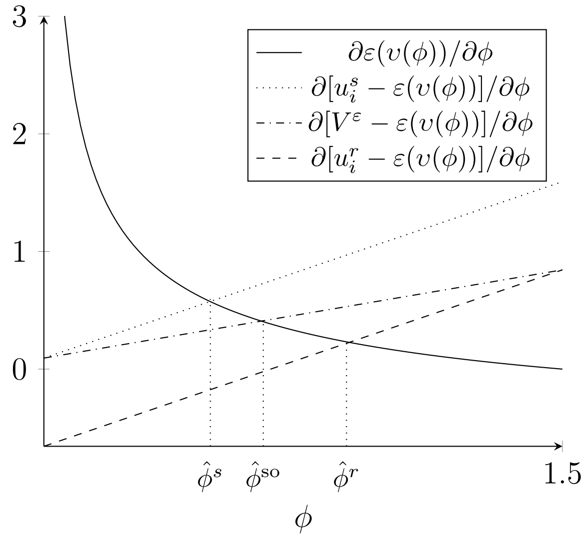


Figure 4: Effects on u_i^ε and V^ε when $R = 1.5$, $p = 0.25$, and $\varepsilon = 2\sqrt{\upsilon} - \upsilon$.

$\upsilon(\phi^{\varepsilon^*}) - \upsilon(\hat{\phi}^{\text{so}}) > 0$ *if* $\bar{B} < 1/2$.

Every household benefits from the positive externality ε. As a result, the social planner's, as well as political candidates' decision is pushed upward by this (externality) effect (see $\partial\varepsilon(\upsilon(\phi))/\partial\phi$ in Figure 4). Moreover, in a way that is analogous to the baseline analysis, households are subject to the interaction between the redistributive and the allocative effect. Households maximizing their payoff implementing the safe project are harmed by the redistributive effect, which becomes stronger as the mass of beneficiaries from guarantees becomes larger (see $\partial[u_i^s - \varepsilon(\upsilon(\phi))]/\partial\phi$ in Figure 4). Households maximizing their payoff implementing the risky project benefit from the redistributive effect, yet they demand less generous guarantees as the allocative effect becomes larger in order to tame the mass of beneficiaries (see $\partial[u_i^r - \varepsilon(\upsilon(\phi))]/\partial\phi$ in Figure 4). At the same time, the shift of capital from the safe to the risky project (i.e., a merely allocative concern) is the force that constraints the social planner's choice of loan guarantees (see $\partial[V^\varepsilon - \varepsilon(\upsilon(\phi))]/\partial\phi$ in Figure 4).

The distance between $\hat{\phi}^s$, $\hat{\phi}^{\text{so}}$ and $\hat{\phi}^r$, as well as the choice between $\hat{\phi}^s$ or $\hat{\phi}^r$ depends on the parameters. If the majority of households maximize their payoff when implementing the safe project ($\bar{B} > 1/2$), then candidates choose a level of guarantees that is suboptimally small. Otherwise, candidates cater to a majority that maximizes its payoff when implementing the risky project, which results in a level of guarantees that is more generous than the optimal one. Yet, the mechanism that drives the choice of office-motivated politicians on loan guarantees remains the same: The reason that makes a social planner willing to offer guarantees (in this case the shift of capital from the safe to the risky project) is the one that reins in the generosity of guarantees in a democracy.

5 Conclusion

A planner can use loan guarantees to alleviate a financial constraint, thus shifting capital from the rest of the economy to the recipient sector in a way that maximizes aggregate welfare. But insofar as guarantees are backed by taxpayer's money, they also cause a redistribution from the rest of the economy to borrowers. Office-motivated politicians offer guarantees to the extent a large enough share of the electorate benefits from this redistribution. Yet, the reason that makes a planner offer guarantees in the first place is what constrains the political support for guarantees: The beneficiaries of guarantees are cautious as to the level they demand in order to tame the base among which the seeds of redistribution are shared.

Appendix

Proof of Proposition 1

Because of (8) we know that $\iota(\hat{\phi}_i^n)\hat{\phi}_i^n = 0$, and therefore (from (6)) $\nu_i^n(\hat{\phi}_i^n) = 0$. We also obtain that $\nu_i^b(\bar{\phi}_i) \geq \nu_i^n(\hat{\phi}_i^n)$ for every $\kappa \leq (pR-1)/(2-pR)$, which holds because of Assumption 2. This means that every household prefers $\bar{\phi}_i$ over $\hat{\phi}_i^n$ (which also means by (9) that it prefers $\hat{\phi}_i^b$ over $\hat{\phi}_i^n$) for every $\bar{\phi}_i \leq 1$. It also holds that $\dfrac{1-(1+\kappa)(pR-1)}{2(1+\kappa)(1-p)} > \bar{\phi}_i$ for every $b_i < \bar{b} \equiv \dfrac{1+(pR-1)(1+\kappa)}{2(1+\kappa)}$, which means that $\hat{\phi}_i^b = \min\left\{1, \dfrac{1-(1+\kappa)(pR-1)}{2(1+\kappa)(1-p)}\right\}$ for every $b_i < \bar{b}$, whereas $\dfrac{1-(1+\kappa)(pR-1)}{2(1+\kappa)(1-p)} < \bar{\phi}_i$ for every $b_i > \bar{b}$, which means that $\hat{\phi}_i^b = \bar{\phi}_i$. Finally, a household with $\bar{\phi}_i > 1$ remains a non-borrower for every $\phi \in [0,1]$, and thus has a global maximum at $\phi = 0$.

Because of Assumption 2, we obtain that $\bar{b} > 1/2$, which means that the payoff of more than half of households reaches its global maximum when $\phi = \min\{1, (1-(1+\kappa)(pR-1))/(2(1+\kappa)(1-p))\}$. Let candidates choose $\phi_j = \min\{1, (1-(1+\kappa)(pR-1))/(2(1+\kappa)(1-p))\}$ for every $j \in \{a,b\}$, which means that households are indifferent among candidates, and therefore, $v_a = v_b = 1/2$. Since at least half of households have a global maximum at $\phi = \min\{1, (1-(1+\kappa)(pR-1))/(2(1+\kappa)(1-p))\}$, we know that any deviation will cause a decrease of the vote share of the deviating candidate below 1/2. By the same reasoning, we know that for any pair (ϕ_a, ϕ_b) with at least one candidate choosing a policy deviating from $\min\{1, (1-(1+\kappa)(pR-1))/(2(1+\kappa)(1-p))\}$, at least one candidate can increase his vote share by choosing a policy that is equal to $\min\{1, (1-(1+\kappa)(pR-1))/(2(1+\kappa)(1-p))\}$. We have thus shown that there is no deviation from $\phi_j = \min\{1, (1-(1+\kappa)(pR-1))/(2(1+\kappa)(1-p))\}$ with $j \in \{a,b\}$ that can increase a candidate's vote share, whereas at least one candidate can increase his vote share by deviating from any $\phi \neq \min\{1, (1-(1+\kappa)(pR-1))/(2(1+\kappa)(1-p))\}$. Therefore, $\phi_j^* = \min\{1, (1-(1+\kappa)(pR-1))/(2(1+\kappa)(1-p))\}$ for every $j \in \{a,b\}$ is the unique equilibrium under Assumptions 1 and 2. □

Proof of Proposition 2

We consider the case where $\bar{\phi}_1 = (2 - pR)/(1 - p) < 1$. From Definition 1, we write

$$V(\phi) = \int_0^1 \nu_i di = \begin{cases} \int_0^{pR+(1-p)\phi-1} [pR + (1-p)\phi - 1] \; di \\ + \int_{pR+(1-p)\phi-1}^{1} 0 \; di & \forall \phi \in \left[0, \dfrac{2-pR}{1-p}\right] \\ - (1-p)\left((pR-1)\phi + (1-p)\phi^2\right)(1+\kappa) \\ \int_0^1 [pR + (1-p)\phi - 1] \; di - (1-p)\phi(1+\kappa) & \forall \phi > \dfrac{2-pR}{1-p}. \end{cases} \tag{32}$$

We further write

$$V(\phi) = \begin{cases} (pR - 1 + (1-p)\phi)^2 & \forall \phi \in \left[0, \dfrac{2-pR}{1-p}\right] \\ - (1-p)\left((pR-1)\phi + (1-p)\phi^2\right)(1+\kappa) \\ pR + (1-p)\phi - 1 - (1-p)\phi(1+\kappa) & \forall \phi > \dfrac{2-pR}{1-p}. \end{cases} \tag{33}$$

We note that $V(\phi)$ is continuous with respect to ϕ, has a maximum at

$$\phi = \min\left\{\frac{(pR-1)(1-\kappa)}{2(1-p)\kappa}, \frac{2-pR}{1-p}\right\} \tag{34}$$

in the interval $\left[0, \dfrac{2-pR}{1-p}\right]$, and is decreasing with respect to ϕ for every $\phi > \dfrac{2-pR}{1-p}$. Assumptions 1 and 2 ensure that $\min\left\{\dfrac{(pR-1)(1-\kappa)}{2(1-p)\kappa}, \dfrac{2-pR}{1-p}\right\} > 0$. The preceding analysis also suffices to show that $V(\phi)$ is maximized by $\min\left\{1, \dfrac{(pR-1)(1-\kappa)}{2(1-p)\kappa}\right\}$ in case $\bar{\phi}_1 > 1$. The characterization of ϕ^{so}, as given by (12), follows immediately, where ϕ^{so} is defined by Definition 1.

Comparing (10) and (12), and taking into account that $\phi^* < \bar{\phi}_1$ as known from the proof of Proposition 1, we obtain that $\phi^* < \phi^{\text{so}}$ for every $\kappa < (pR-1)/(2-pR)$, which holds because of Assumption 2. This, and taking (5) into account, implies that

$\iota(\phi^*) \leq \iota(\phi^{so})$, under Assumption 2. □

Proof of Proposition 3

The two candidates face a symmetric problem. It thus suffices to solve the problem of one candidate, say candidate a. If $\phi_a > \bar{\phi}_1$, then $\iota(\phi_a) = 1$ and $\nu_i(\phi_a) = pR - 1 - \kappa(1-p)\phi_a$ for every $i \in [0,1]$. This means that every household's payoff is decreasing in ϕ_a for every $\phi_a > \bar{\phi}_1$. It follows that there is no equilibrium with $\phi_a > \bar{\phi}_1$. Therefore, we look for an equilibrium satisfying $\phi_a \in [0, \min\{1, \bar{\phi}_1\}]$.

Let $0 < \phi_a < \phi_b < \min\{1, \bar{\phi}_1\}$. From the voting behavior described in Subsection 4.1 (see also Figure 3), we obtain

$$\begin{aligned} v_a = &[pR - 1 + (1-p)\phi_a] \cdot \left[\frac{1}{2} + \psi \cdot \left(u_i^b(\phi_a) - u_i^b(\phi_b)\right)\right] \\ &+ (1-p) \cdot (\phi_b - \phi_a) \cdot \left[\frac{1}{2} + \psi \cdot \left(u_i^n(\phi_a) - u_i^b(\phi_b)\right)\right] \\ &+ [2 - pR - (1-p)\phi_b] \cdot \left[\frac{1}{2} + \psi \cdot (u_i^n(\phi_a) - u_i^n(\phi_b))\right]. \end{aligned} \tag{35}$$

We re-write

$$\begin{aligned} v_a =&\frac{1}{2} \\ &+ \psi \cdot u_i^b(\phi_a) \cdot (pR - 1 + (1-p)\phi_a) \\ &- \psi \cdot u_i^b(\phi_b) \cdot (pR - 1 + (1-p)\phi_b) \\ &+ \psi \cdot u_i^n(\phi_a) \cdot (2 - pR - (1-p)\phi_a) \\ &- \psi \cdot u_i^n(\phi_b) \cdot (2 - pR - (1-p)\phi_b). \end{aligned} \tag{36}$$

We then obtain

$$\frac{\partial v_a}{\partial \phi_a} = \psi(1-p)\left((pR-1)(1-\kappa) - 2\kappa(1-p)\phi_a\right). \tag{37}$$

and

$$\frac{\partial^2 v_a}{\partial \phi_a^2} = -\psi(1-p)^2 2\kappa < 0. \tag{38}$$

Hence, and taking into account that candidate b faces a symmetric problem, we obtain that there is a unique equilibrium where candidate $j \in \{a,b\}$ sets $\frac{(pR-1)(1-\kappa)}{2(1-p)\kappa}$ if there is $\phi \in [0, \min\{1, \bar{\phi}_1\}]$ that makes $\frac{\partial v_a}{\partial \phi_a} = 0$. If $\frac{\partial v_a}{\partial \phi_a} < 0$ for every $\phi \in [0, \min\{1, \bar{\phi}_1\}]$, then both candidates choose zero guarantees, whereas both candidates choose the corner solution $\min\{1, \bar{\phi}_1\}$ if $\frac{\partial v_a}{\partial \phi_a} > 0$ for every $\phi \in [0, \min\{1, \bar{\phi}_1\}]$. □

Proof of Proposition 4

We first note that households' preferences are exactly as in the preceding analysis for every $\phi < \check{\phi}$, where $\check{\phi}$ is defined by (19). Mere observation of (20) and (21) suffices to know that all households' payoff is decreasing in ϕ for every $\phi > \check{\phi}$. This means that there is no equilibrium with $\phi_j > \min\{\check{\phi}, \bar{\phi}_1, 1\}$ for every $j \in \{a,b\}$. Following the reasoning of the proof of Proposition 3, we obtain that there is a unique equilibrium where candidate $j \in \{a,b\}$ sets $\frac{(pR-1)(1-\kappa)}{2(1-p)\kappa}$ if there is $\phi \in [0, \min\{1, \check{\phi}, \bar{\phi}_1\}]$ that makes $\frac{\partial v_a}{\partial \phi_a} = 0$, where $\frac{\partial v_a}{\partial \phi_a}$ is given by (37). If $\frac{\partial v_a}{\partial \phi_a} < 0$ for every $\phi \in [0, \min\{1, \check{\phi}, \bar{\phi}_1\}]$, then both candidates choose zero guarantees, whereas both candidates choose the corner solution $\min\{1, \check{\phi}, \bar{\phi}_1\}$ if $\frac{\partial v_a}{\partial \phi_a} > 0$ for every $\phi \in [0, \min\{1, \check{\phi}, \bar{\phi}_1\}]$. □

Proof of Proposition 5

Let us consider a household which implements the safe project. We know from (25) that the payoff of this household reads

$$\nu_i^s = R - 1 - (1-p)(1-(1-p)(R-\phi))\phi + \varepsilon(1-(1-p)(R-\phi)) \tag{39}$$

for every $R - 1/(1-p) < \phi < R$. This means that

$$\frac{\partial \nu_i^s}{\partial \phi} = (1-p) \cdot (\varepsilon'(1-(1-p)(R-\phi)) + (1-p)(R-2\phi) - 1), \tag{40}$$

and $\frac{\partial^2 u_i^s}{\partial \phi^2} = (1-p)(\varepsilon'' - 2) < 0$. We then write the first-order condition

$$\varepsilon'(1-(1-p)(R-\phi)) = (1-p)(2\phi - R + 1/(1-p)). \tag{41}$$

The left-hand side is strictly decreasing taking values from $+\infty$ to 0 as ϕ takes values from $R - 1/(1-p)$ to R. The right-hand side is increasing in ϕ, taking values from $(1-p)R-1$ to $(1-p)R+1$ as ϕ takes values from $R-1/(1-p)$ to R. We thus conclude that there is $\hat{\phi}^s$ that solves (41). It also holds that there is no household implementing the safe project if $\phi > R$, ν_i^s is constant for every $\phi < R - 1/(1-p)$, and ν_i^s is continuous for every $\phi \in [0, R]$. The above suffice to conclude that $\hat{\phi}^s \in (R - 1/(1-p), R)$ is the unique value that maximizes the utility of a household implementing the safe project.

We next study a household which implements the risky project. We know from (25) that the utility of this household reads

$$\nu_i^r = b_i + pR - 1 + (1-p)\phi - (1-p)(1-(1-p)(R-\phi))\phi + \varepsilon(1-(1-p)(R-\phi)) \tag{42}$$

for every $R - 1/(1-p) < \phi < R$. This means that

$$\frac{\partial u_i^r}{\partial \phi} = (1-p) \cdot (\varepsilon'(1-(1-p)(R-\phi)) + (1-p)(R-2\phi)), \tag{43}$$

and $\frac{\partial^2 u_i^r}{\partial \phi^2} = (1-p)^2(\varepsilon'' - 2) < 0$. We then write the first-order condition

$$\varepsilon'(1-(1-p)(R-\phi)) = (1-p)(2\phi - R). \tag{44}$$

The left-hand side is strictly decreasing taking values from $+\infty$ to 0 as ϕ takes values from $R - 1/(1-p)$ to R. The right-hand side is increasing in ϕ, taking values from $(1-p)R-2$ to $(1-p)R$ as ϕ takes values from $R-1/(1-p)$ to R. We thus conclude that there is $\hat{\phi}^r$ that solves (44). It also holds that there is no household implementing the risky project if $\phi < R-1/(1-p)$, ν_i^r is constant for every $\phi > R$, and ν_i^r is continuous for every $\phi \geq R-1/(1-p)$. The above suffice to conclude that $\hat{\phi}^r \in (R-1/(1-p), R)$ is the unique value that maximizes the utility of a household implementing the risky project.

Aggregate welfare reads

$$V^\varepsilon = \int_0^{(1-p)(R-\phi)} (R-1)di + \int_{(1-p)(R-\phi)}^1 (b_i + pR - 1)di + \varepsilon(1-(1-p)(R-\phi)) \quad (45)$$

for every $\phi \in (R-1/(1-p), R)$. Using that $b_i = i$, we then obtain

$$\frac{\partial V^\varepsilon}{\partial \phi} = (1-p)\cdot(\varepsilon'(1-(1-p)(R-\phi)) - (1-p)\phi), \quad (46)$$

and $\dfrac{\partial^2 V^\varepsilon}{\partial \phi^2} = -(1-p)^2(\varepsilon'' - 1) < 0$. We then write the first-order condition

$$\varepsilon'(1-(1-p)(R-\phi)) = (1-p)\phi. \quad (47)$$

The left-hand side is strictly decreasing taking values from $+\infty$ to 0 as ϕ takes values from $R - 1/(1-p)$ to R. The right-hand side is increasing in ϕ, taking values from $(1-p)R-1$ to $(1-p)R$ as ϕ takes values from $R-1/(1-p)$ to R. We thus conclude that there is $\hat{\phi}^{\text{so}}$ that solves (47). It also holds that V^ε is constant for every $\phi < R-1/(1-p)$ and every $\phi > R$, and V^ε is continuous for every $\phi \geq 0$. The above suffice to conclude that $\hat{\phi}^{\text{so}} \in (R-1/(1-p), R)$ is the unique value that maximizes aggregate social welfare.

By solving $\nu_i^s(\hat{\phi}^s) \geq \nu_i^r(\hat{\phi}^r)$ with respect to b_i, we obtain that there is threshold

$$\bar{B} \equiv (1-p) \cdot \Big(R - \hat{\phi}^r (1 - \upsilon(\hat{\phi}^r)) - \hat{\phi}^s \upsilon(\hat{\phi}^s) + \varepsilon(\upsilon(\hat{\phi}^s)) - \varepsilon(\upsilon(\hat{\phi}^r)) \Big) \tag{48}$$

so that if $\bar{B} \geq 1/2$, then the majority of households maximize their utility with $\hat{\phi}^s$, and otherwise with $\hat{\phi}^r$. Following the reasoning of the proof of Proposition 1, we then obtain that $\phi_j^{\varepsilon^*} = \phi^{\varepsilon^*} = \hat{\phi}^s$ when $\bar{B} \geq 1/2$ for every $j \in \{a, b\}$, whereas $\phi_j^{\varepsilon^*} = \phi^{\varepsilon^*} = \hat{\phi}^r$ when $\bar{B} < 1/2$ for every $j \in \{a, b\}$. By comparing the right-hand side of (41), (44) and (47), we conclude that $\hat{\phi}^s < \hat{\phi}^{\text{so}} < \hat{\phi}^r$. This means that $\upsilon(\phi^{\varepsilon^*}) < \upsilon(\hat{\phi}^{\text{so}})$ when $\bar{B} \geq 1/2$, whereas $\upsilon(\phi^{\varepsilon^*}) > \upsilon(\hat{\phi}^{\text{so}})$ when $\bar{B} < 1/2$. □

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