Additionality and Collateral Substitution with Government-Financed Guarantee Funds*

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Abstract

We study banks´ collateral substitution behaviour in the presence of a government-financed guarantee program where banks have enough information to distinguish between good and bad borrowers, but a preexisting distortion caused by prudential regulation, excludes some good borrowers that otherwise banks would like to finance. We show that in order to avoid collateral substitution and increase additionality a government-financed guarantee program should consider large individual loan coverages but at the same time the amount of public gurantee allocated to each bank should be small. When the individual coverage rate is small, it is more profitable for a bank to use the public guarantee to fully collateralize borrowers with enough illiquid wealth who would receive credit without a public guarantee, and extract the additional surplus with a higher interest rate. By contrast, when the individual coverage rate is large the cost of prudential regulation becomes irrelevant for all borrowers and the bank only compares how much surplus it can extract from a borrower. Finally, we also show that the total amount guaranteed by the public fund for a particular bank should be limited because once all formerly redlined good borrowers obtain credit further additions only lead to collateral substitution.

Keywords: government-financed guarantee programs, collateral substitution, credit additionality

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1. Introduction

Government-financed guarantee funds have being for decades hallowed by governments the world over as necessary to overcome credit market imperfections[1]. But results have been bad and most of the time state-financed guarantees have led to massive waste of resources and non-performing loans[2].

The standard policy argument in favor of guarantees is that they correct market failures which exclude creditworthy firms from the credit market. These can be classified in four groups[3]. First, they can overcome collateral constraints and compensate for low profit margins, thus increasing access to credit (also called *additionality*). Second, they offset the risks of lending to small and microborrowers. Third, they address information constraints. Last, they improve the productive efficiency of borrowers and induce learning. Yet, as is well known, this view is somewhat naive and ignores that one of the main roles of banks is to tell apart "good" borrowers (the hard-working, able and honest) from "bad" borrowers (the lazy, incompetent or dishonest). Surely some creditworthy firms are excluded by asking for collateral. But that is the price for lending to good borrowers most of the time, thus making the credit market viable.

The first aim of the paper is to study banks´ behaviour in the presence of a government-financed guarantee program. As suggested by Vogel and Adams (1997), when a government-financed guarantee program exists, banks might have incentives to engage in portfolio substitution by transfering some of the qualifying portion of its existing loan portfolio to the guarantee program and then expand his lending to, up to then, non elegible borrowers. We analyse this portfolio substitution behaviour in a context where banks have enough information to distinguish between good and bad borrowers and a preexisting distortion excludes some good borrowers that otherwise banks would like to finance. In this case, we assume that the preexisting "distortion" is caused by prudential regulation, which increases the cost of lending to borrowers who have no guarantees.[4] Because in our model banks are fully informed about the type of borrowers they face, collaterals play no role as a mechamism for enforcing loan contracts as in Barro (1976) and Benjamin (1978), or as a mechanism to identify borrowers' type as in Besanko and Thakor (1987), nor as a mechanism

[1] According to a survey conducted by Graham Bannock and Partners, in 1995 there were at least 85 countries with some type of government credit guarantee program. Cited by De la Torre et al. (2007,p.32).

[2] De la Torre et al. (2007) state that the general experience with credit guarantee systems has been poor, especially in developing countries, and that most systems have depleted their reserves due to credir losses and poor investment decisions. See also Green (2003).

[3] This is based on Gudger (1998).

[4] Of course, we are aware that prudential regulation is justified for other reasons. One might argue that one should remove the distortion by relaxing prudential requirements so that good borrowers with little collateral may receive credit. Nevertheless, prudential risk assessment must be based on verifiable (or hard) information. For obvious reasons, subjective creditworthiness assessments made by the credit officers of the interested bank cannot be used in prudential risk assessments.

to compensate for differences in lenders' and borrowers' valuation of the project being financed as in Chan and Kanatas (1985).

Based in these premises we build a model with good and bad borrowers where, due to prudential regulation, banks face a greater cost of financing borrowers that do not pledge a collateral. We also assume that borrowers with larger illiquid wealth have better outside options if they do not borrow from a bank and therefore the bank who ask for more collateral for a given loan size can charge a lower interest rate[5]. We show (the fairly obvious) result that an unbounded guarantee fund (i.e. in one that any loan is fully guaranteed) will be abused by the bank. Of course, good borrowers that were previously redlined now receive credit; but so do bad borrowers. Moreover, the bank earns more money by substituting private collateral for a public guarantee. Hence, an unbounded guarantee fund stimulates both the financing of bad borrowers and the substitution of public for private guarantees.

We then study the characteristics of a government-guarantee program that reaches only good borrowers who were previously excluded by banks[6]. The main result is as follows: on the one hand, one should grant a very high individual coverage rate, close to 100%; but, on the other hand, the total amount guaranteed by the public fund should be "small". We also show that as the individual coverage rate falls, substitution of public for private guarantees increases.

What is the economics of these results? Consider first why the individual coverage rate should be small. A bank can use a public guarantee for at least two different purposes. On the one hand, it can back a loan of a good borrower with little illiquid wealth who cannot post much collateral and is too expensive to be financed; in this case, the public guarantee fosters access to credit. On the other hand, it can use the public guarantee to substitute for the collateral posted by a borrower with enough illiquid wealth, extracting the higher surplus through a higher interest rate; in this case the public guarantee just substitutes for private ones. Therefore, the allocation of the guarantee will depend on which use increases bank profits the most.

Now when the individual coverage rate is small, it is more profitable for the bank to use the public guarantee to fully collateralize borrowers with enough illiquid wealth who would receive credit without a public guarantee, and extract the additional surplus with a higher interest rate. Essentially, a small public guarantee reduces the cost imposed by prudential regulation too little. By contrast, when the individual coverage rate is large the cost of prudential regulation becomes irrelevant for all borrowers—all have a lot of collateral and are safe borrowers. Thus, the bank only compares how much surplus it can extract from a borrower. Provided that the outside option of a

[5]Note that the inverse relationship between the interest rate and the amount of collateral a borrower can pledge is different that the one in Besanko and Thakor (1987) where the collateral serves as a selection mechanism.

[6]Of course, this also applies to credit-constrained borrowers. The aim here is that the public guarantee is used only to back additional credits to good borrowers.

borrower improves with her illiquid wealth, borrowers with little illiquid wealth are more profitable. Last, it is now easy to see why the he total amount guaranteed by the public fund should be "small": once all formerly redlined good borrowers obtain credit, further additions only lead to substitution.

The rest of the paper proceeds as follows. In section 2 we present the model. Section 3 concludes with some suggestions for improving government-financed guarantee funds.

2. A simple formal analysis of guarantee funds

The possible outcomes from a state-financed guarantee program are three. Assume that before the guarantee program banks lend only to good borrowers, but some are excluded because they lack collateral. The aim of a guarantee program is to finance good borrowers who are previously excluded from the credit market. But it can also have two undesirable effects. First, the public guarantee may be used to back loans that would have been made anyway, but backed with private guarantees. Second, it may prompt the bank to relax its standards and lend to bad borrowers—the bank engages in moral hazard, induced by state-financed guarantees. Is there any design to ensure that guarantees end up backing loans to only good but excluded borrowers? In what follows we will show that under a specific set of circumstances the answer is yes.

2.1. The model

Model description Assume that there is a risk-neutral bank and a continuum of risk-neutral borrowers of mass N, each with a one-period project that requires investment I. A small fraction λ of borrowers are "good" (g) and a large fraction $1-\lambda$ are "bad" (b). Banks know which borrowers are good and which are bad.

A project run by a good borrower succeeds with probability p_g and returns $R > (1+\rho)I$, where ρ is the bank's opportunity cost of funds. It fails with probability $1-p_g$, in which case all is lost. Of course, $p_g R - (1+\rho)I > 0$. By contrast, a project run by a bad borrower succeeds with probability $p_b < p_g$, and loses money in expected value, that is $p_b R - (1+\rho)I < 0$. For simplicity, henceforth we assume that $\rho = 0$. Hence

$$p_g R - I > 0 > p_b R - I.$$

The regulator values collateral. If the bank lends I to a borrower that promises to repay $(1+r)I$ and posts collateral C, the bank must substract $\alpha(I-C)$ from current profits as provisions, with $\alpha \in (0,1)$. We will assume that

$$p_g R - (1+\alpha)I < 0.$$

That is, good borrowers that put up no collateral are too expensive to finance. We assume that borrowers' illiquid wealth is distributed according to the cdf $\mathcal{C}(w)$, with support $[0, W]$, with $W > I$.

Some useful expressions In what follows it will be useful to work with expressions for a borrower's participation constraint and for bank profits when making a loan. The participation constraint of a borrower is

$$p[R - (1 + r)I] - (1 - p)C \geq u(w), \tag{2.1}$$

where $u(w)$ is her outside option. We assume that $u_g(0) = 0$, $u'_g > 0$; that is, the outside option of the good borrower improves with her illiquid wealth, *ceteris paribus* (perhaps because a borrower with collateral can better play banks against one another). By contrast, $u_b(w) = 0$ for all $w \in [0, W]$. That is, the outside option of a bad borrower does not improve with her illiquid wealth.

On the other hand, the bank's payoff when making a loan is

$$\pi \equiv p(1 + r)I + (1 - p)C - I - \alpha(I - C). \tag{2.2}$$

We will assume that the bank has all the bargaining power, which is constrained only by the borrower's outside option $u(w)$. It follows that whenever the bank lends, r and C are such that

$$pR - p(1 + r)I - (1 - p)C = u(w). \tag{2.3}$$

Note that the borrower's participation constraint (2.3) implies that there is set of pairs (r, C) such that the constraint is met. A bank who asks for more collateral must charge less for the credit it gives.

It also follows from (2.3) that the bank's profit (2.2) can be rewritten as

$$\pi = pR - I - u(w) - \alpha(I - C). \tag{2.4}$$

Note that as long as (2.3) is met, the bank's profit does not depend on the interest rate charged. And were it not for prudential regulation, it would not depend on collateral C either. This is just a straightforward implication of the fact that the borrower's participation constraint always binds.

2.2. Behavior with no guarantees

Assume, to begin, that there is no state-run guarantee program. The first result shows that bad borrowers will never be financed.

Result 2.1. *Bad borrowers will not be financed.*

Proof. It follows directly from (2.4), noting that $p_b R - I < 0$. ■

The intuition behind this result is straightforward. Because $p_b R - I < 0$, bad borrowers do not generate enough surplus to pay for the opportunity cost of funds, and banks do not want to lend to them. Of course, banks would be willing to finance if a bad borrower puts up enough collateral. But bad borrowers won't be willing to do that, because in that case the project will not generate enough surplus to warrant it.

The next result shows that banks will finance good borrowers who put up enough collateral.

Result 2.2. *There exists good borrowers that will be financed. But, because of prudential regulation some good borrowers will be excluded.*

Proof. To prove the first part, note that good borrowers with enough illiquid wealth will be able to fully collateralize their debt. In that case banks earn

$$p_g R - I - u_g(w) > 0,$$

where the inequality follows from the assumption that $p_g R - I - u(W) > 0$. The second part follows directly from the assumption that $p_g R - (1+\alpha)I < 0$. Last, because $u_g' > 0$, it follows that there exists $w^* \in (0, I)$ such that the bank's profit equals exactly zero. ■

It is also interesting to note that banks will ask for as much collateral as possible. This may seem surprising, given that the expected surplus that can be extracted from each borrower is given by her outside option, and hence the bank does not care directly about the amount of collateral. Nevertheless, the amount of collateral affects the bank's profit through the provision requirements imposed by prudential regulation. The more collateral, the higher are profits.

Result 2.3. *Because of prudential regulation, banks will ask for as much collateral as possible.*

2.3. Unbounded public guarantees

We can now add publicly funded guarantees. To begin, we will assume that the bank can use as much guarantees as it likes—the public guarantee fund is unbounded. Let ηI be the maximum amount guaranteed by the public program, and G the public guarantee actually granted by the bank. Then the bank's profit equals

$$\begin{aligned} \pi &= [p(1+r)I + (1-p)C - I] + (1-p)G - \alpha(I - C - G) \\ &= [pR - I - u(w)] + (1-p)G - \alpha(I - G - C). \end{aligned}$$

It is clear that the bank's profit is increasing in the guarantee. The public guarantee adds to the borrower's collateral, thus increasing the bank's payoff in the default state and, moreover, reduces the cost of prudential regulation.

What is not so obvious, however, is that the bank can gain even more by substituting publicly-funded guarantees for the borrower's collateral, because it can extract more from the borrower by reducing C and increasing r. Of course, without a guarantee increasing r would be self-defeating: whatever is gained with a higher r in the good state, is lost in the bad state with less collateral. But with a publicly funded guarantee the bank can both reduce C *and* receive the money back in the bad state by using the guarantee. Hence

Result 2.4. *Let ηI be the maximum individual loan guarantee. Then the bank sets $G = \eta I$*

Thus Result 2.4 implies that the bank will substitute guarantees for the collateral of good borrowers. Moreover, if the public guarantee is such that all loans are fully guaranteed, now the bank will want to lend to bad borrowers, for now it earns

$$p_b R - I + (1 - p_b)I = p_b(R - I) > 0,$$

where the inequality follows from the fact that $R - I > 0$. And the bad firm will accept the loan: note that with a guarantee her equilibrium payoff is

$$p_b[R - (1 + r)I] = 0,$$

with $r > 0$ because $R - I > 0$. We can summarize this as follows:

Result 2.5. *Unlimited publicly-funded guarantees induce moral hazard on the part of the bank: substitution of guarantees for collateral and lending to bad borrowers.*

Note that the demand for guarantees is thus very large; so is the expected loss of the guarantee fund, viz.

$$\lambda N(1 - p_g)I + (1 - \lambda)N(1 - p_b)I. \tag{2.5}$$

Expession (2.5) just restates what we already know: because the potential number of borrowers in very large, and most of them are bad, an unbounded guarantee program creates very large losses. Moreover, such a program destroys wealth as well, in the amount

$$\lambda N \cdot \mathcal{C}(w^*)(p_g R - I) + (1 - \lambda)N(p_b R - I) < 0.$$

Of course, lending to the $\lambda N \cdot \mathcal{C}(w^*)$ good borrowers formerly excluded from the credit market creates wealth. But because $p_b R - I < 0$ and $(1 - \lambda)N$ is very large, the social loss wrought by the guarantee fund also is.

2.4. Bounded public guarantees

Can guarantees ever be useful? The trick would be to finance only good borrowers with wealth less than w^*. We will now deduce conditions under which guarantees end up financing *only* good borrowers who would otherwise be redlined. The key features of a successful guarantee program are the following. One is that the bank must be able to identify good borrowers using something other than collateral. Also, once a guarantee is in place, lending to good borrowers with little collateral must be more profitable for the bank than the alternatives. And while the per-borrower guarantee must be large, the guarantee fund must be bounded and "small" (below we will make precise what we mean by "small"). Last, if the rate of default on loans that receive the guarantee is greater than the rate of defaults of similar loans that do not, then the bank should be excluded from future allocations of the guarantee fund.

The first condition is straightforward. It is clear that publicly funded guarantees do not create any new information. As long as this is so, any successful program must rely on information that the bank can acquire *beyond the willingness of the borrower to put up collateral*. We now study the other three.

Small individual coverage rates To study the other three conditions, assume for the moment that its in the bank's interest to lend only to good borrowers. It is clear that the public guarantee increases the range of w's for which the bank does not lose money. For a given guarantee level η, the lower bound is now given by

$$(1-p_g)\eta I + \alpha I + [p_g R - u(w^*(\eta)) - (1+\alpha)I + \alpha w^*(\eta)] = 0, \tag{2.6}$$

which is clearly less than w^*. But, of course, if the guarantee fund is limited it does not follow that the bank will use the guarantee to lend to borrowers with illiquid wealth w in the interval $[w^*(\eta), w^*)$. Public guarantees will be allocated to those borrowers that increase the bank's profit the most. It is straightforward (if tedious) to show that if the public guarantee equals ηI, the increase in profits for a borrower with illiquid wealth w and individual coverage rate η, call it $\Delta_g(\eta, w)$, is

$$\begin{array}{ll}
(1-p_g)\eta I, & w \geq I; \\
(1-p_g)\eta I + \alpha(I-w), & (1-\eta)I \leq w < I; \\
(1-p_g)\eta I + \alpha\eta I, & w^* \leq w < (1-\eta)I; \\
(1-p_g)\eta I + \alpha\eta I + [p_g R - u(w) - (1+\alpha)I + \alpha w], & w^*(\eta) \leq w < w^*.
\end{array}$$

(see the Appendix for the full derivation, and Figure 1, where $\eta < \eta'$). It is useful to look at the sources of differences between borrowers. Note first that the term $(1-p_g)\eta I$ appears in all expressions. Essentially, the public guarantee is a subsidy paid in the bad state, which occurs with probability $1-p_g$. Because the borrower's outside option doesn't change with the public guarantee, banks get all the additional profits. The following result is apparent:

Result 2.6. *A public guarantee program increases bank's profits; are increasing in η.*

It is clear that this result follows from the assumption that the public guarantee does not increase the value of the firm's outside option. Yet it seems a fair description of what happens in practice. For one, public guarantees usually are not transferrable from one bank to another. For another, most small borrowers, which public guarantee programs target, tend to have relationships with only one bank.

For borrowers with illiquid wealth larger than I , $(1-p_g)\eta I$ is the only increase in profits wrought by the public guarantee. By contrast, for for borrowers with $w < I$, a second term appears, $\alpha(I-w)$ or $\alpha\eta I$ as the case may be. This term captures the saving in the costs imposed by prudential regulation. For borrowers who end up fully collateralized (those with illiquid wealth such that $(1-\eta)I \leq w < I$) the saving is proportional to the additional guarantee, $I-w$; for borrowers with smaller illiquid wealth, it is proportional to the full public guarantee, ηI. Clearly, the *marginal* saving is greater for those with less illiquid wealth, for they do not substitute public for private guarantees in the margin.

Last, consider the term $p_g R - u(w) - (1+\alpha)I + \alpha w$. This is the *loss* that the bank would incur lending to a good borrower with illiquid wealth such that $w^*(\eta) \leq w < w^*$. Without a public guarantee these borrowers would not get any credit. The subsidy $(1-p_g)\eta I + \alpha\eta I$, however, is enough to make them profitable. Nevertheless, the profit decreases as w does.

Now in practice the guarantee fund is limited, and it is apparent from Figure 1 that there is a pecking order among borrowers. To discuss it, and to keep the terminology clear, it is useful to define "small" and "large" individual coverage rates.

Definition 2.7. *Let η^* be defined by $(1-\eta^*)I \geq w^*$. An individual coverage rate is* small *if $\eta < \eta^*$, and* large *otherwise.*

Thus, Figure 1 depicts the case of small individual coverage rates. The following is apparent:

Result 2.8. *If the individual public guarantee is small, then public guarantees are first allocated to borrowers that would receive credit anyway.*

Result 2.8 indicates that the public guarantee fund may just substitute public for private guarantees, without granting additional credits. In fact, with a small individual coverage rate η, the only way of reaching good borrowers is to increase the size of the total fund. As is suggested by Figure 1, when all borrowers with illiquid wealth such that $w^* \leq w < (1-\eta)I$ are covered, then some of the guarantees will stimulate new credits, but substitution will increase as well.

Figure 1 also shows a nonobvious implication of the model: as η falls, and for a given size of the total fund (call it F), substitution of public for private guarantees should increase. This has an important implication, namely that when the guarantee fund is allocated to the bank that offers the lowest individual coverage rate η (as Fogape is), substitution is encouraged.

Result 2.9. *Ceteris paribus, the smaller the individual coverage rate, the larger the substitution of private guarantees, and the smaller the creation of new loans.*

2.4.1. Large individual coverage rates

We now examine the pecking order of borrowers when the individual coverage rate is large, i.e. $(1-\eta)I < w^*$. It is then straightforward to show that if the public guarantee equals ηI, $\Delta_g(\eta, w)$ is now

$$
\begin{array}{ll}
(1-p_g)\eta I, & w \geq I; \\
(1-p_g)\eta I + \alpha(I-w), & w^* \leq w < I; \\
(1-p_g)\eta I + \left[p_g R - u(w) - I\right], & (1-\eta)I \leq w < w^* \\
(1-p_g)\eta I + \alpha\eta I + \left[p_g R - u(w) - (1+\alpha)I + \alpha w\right], & w^*(\eta) \leq w < (1-\eta)I.
\end{array}
$$

(see the Appendix for the full derivation, and Figure 2, where $\eta < \eta'$). Now all borrowers with illiquid wealth greater than $(1-\eta)I$ are fully guaranteed. This includes some borrowers who would not get credit without the public guarantee.

The most important implication of this latter fact can be gleaned from Figure 2: now the pecking order is reversed, and the following result follows:

Result 2.10. *If the individual public guarantee is large, then they are first allocated to borrowers that otherwise do not receive credit.*

What is the economics behind this result? To appreciate it note that if borrower w^* receives guarantee ηI, it will be fully collateralized and generate

$$p_g R - u(w^*) - I + (1-p_g)\eta I$$

in additional profits for the bank.[7] In turn, when a formerly redlined good borrower becomes fully collateralized thanks to the guarantee, the incremental profit it generates for the bank, if it receives

[7] This follows from the fact that $p_g R - u(w^*) - I + (1-p_g)\eta I$ is the total profit generated by the borrower when it receives a large individual guarantee, and that the profit with no guarantee, $p_g R - u(w^*) - (1+\alpha)I + \alpha w^*$, by definition of w^* equals zero.

a public guarantee, is

$$p_g R - u(w) - I + (1 - p_g)\eta I.$$

Because the value of the outside option $u(w)$ falls as illiquid wealth w falls, the bank gains most by using the guarantee with formerly redlined borrowers. In fact, when $\eta = 1$ and the public guarantee covers the entire loan, the best borrower is the one with no illiquid wealth! The policy conclusion is now straightforward:

Result 2.11. *A public guarantee should be generous individually, but the fund F should be limited, to prevent substitution.*

A generous individual coverage rate is good if the aim of the program is to help borrowers with little illiquid wealth. But, at the same time, it transfers rents and profits to the bank. This suggests that η should not be the bidding variable. Instead, the bidding variable should be a payment.

2.4.2. Bad borrowers

So far we have assumed that banks will only use the guarantee to lend to good borrowers. Is that assumption warranted?

It is straightforward to show that the incremental profit of lending to a bad borrower when the guarantee is ηI is

$$\Delta_b(\eta, w) = \begin{cases} (1 - p_b)\eta I + (p_b R - I), & w \geq (1 - \eta)I \\ (1 - p_g)\eta I + (p_b R - I) - \alpha[(1 - \eta)I - w] & w < (1 - \eta) \end{cases}$$

Note that because $p_b R - I < 0$, with a small enough guarantee the bank loses money when lending to a bad borrower. Furthermore, as the lowest increase in profits when lending to a good borrower with a public guarantee is $(1 - p_g)\eta I$, it follows that a sufficient condition for a bad borrower not to be preferred over a good one as a candidate for receiving the public guarantee is that

$$(1 - p_b)\eta I + (p_b R - I) < (1 - p_g)\eta I. \tag{2.7}$$

Will ever bad borrowers have priority over good ones when competing for a public guarantee? To study that, assume $\eta = 1$. Then condition (2.7) reduces to

$$p_b(R - I) < (1 - p_g)I.$$

Of course, if p_b is small , then bad borrowers will not substitute for good borrowers. But if bad borrowers are not "too bad", then they will have priority over good ones. Nevertheless, one can show that there always will be a large enough individual coverage rate η such that the banks earns more by choosing a good borrower.

Proposition 2.12. *If η is large enough, then some formerly redlined good borrowers are more attractive than bad borrowers.*

Proof. By lending to a bad borrower the bank increases her profit by at most $p_b(1-\eta I)-(1-\eta)I$ (and by less if the bad borrower is not fully collateralized). By lending to a previously redlined good borrower, the bank increases her profit by $p_g(1-\eta I)-u(w)-(1-\eta)I$. Now, let $\eta = 1$, and consider a good borrower with $w = 0$. But then it is better to give the public guarantee to the good borrower, for $p_b(1-I) < p_g(1-I)$. ■

Proposition 2.12 is important, for it confirms that the most favorable circumstances for guarantees to go to good but (otherwise) redlined borrowers is for the individual coverage rate to be large.

3. Concluding remarks

Prudential regulation usually entails greater costs of funding firm's projects when there is a lack of accurate financial information verifiable by regulators. This greater cost might exclude some credithworthy firms if they are unable to pledge a collateral that reduces the bank's cost of lending even when banks can disciminate between good and bad borrowers. When the role of collateral is restricted to overcome higher prudential regulation costs, a government-financed guarantee program can induce banks to engage in collateral substitution. Substituting the public guarantees for the collateral of good borrowers banks can increase their profits. Moreover, the guarantee program allow them to lend to bad borrowers that without the guarantee would have been redlined. In these cases a government-financed guarantee program does not create additionality but only induces collateral substitution and increases banks' profits.

We have shown that in order to avoid collateral substitution and increase additionality a government-financed guarantee program should consider large individual loan coverages but at the same time the amount of public gurantee allocated to each bank should be small. When the individual coverage rate is small, it is more profitable for a bank to use the public guarantee to fully collateralize borrowers with enough illiquid wealth who would receive credit without a public guarantee, and extract the additional surplus with a higher interest rate. By contrast, when the individual coverage rate is large the cost of prudential regulation becomes irrelevant for all borrowers and the bank only compares how much surplus it can extract from a borrower. Provided that the outside option of a borrower improves with her illiquid wealth, borrowers with little illiquid wealth become more profitable. Finally, the total amount guaranteed by the public fund for a particular bank should be limited because once all formerly redlined good borrowers obtain credit further additions only lead to collateral substitution.

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Appendix

A. Full derivation of the bank's guarantee allocation decision

A.1. Guarantees and bank profits

A.1.1. Good borrowers

The profit obtained by the bank when lending to a good borrower with illiquid wealth w and no guarantee is

$$\pi_g(0,w) = \begin{cases} p_g R - u(w) - I, & w \geq I \\ p_g R - u(w) - (1+\alpha)I + \alpha w, & w^* \leq w < I \\ 0 & w < w^* \end{cases}$$

With a guarantee of a fraction η of the amount lent, it changes to

$$\pi_g(\eta,w) = \begin{cases} p_g R - u(w) - I + (1-p_g)\eta I, & w \geq (1-\eta)I \\ p_g R - u(w) - (1+\alpha)I + \alpha w + (1+\alpha-p_g)\eta I, & w^*(\eta) \leq w < (1-\eta)I \\ 0, & w < w^*(\eta) \end{cases}$$

Where $w^*(\eta)$ is defined such that

$$p_g R - u(w^*(\eta)) - (1+\alpha)I + \alpha w^*(\eta) + (1+\alpha-p_g)\eta I = 0.$$

The following lemma is useful for the characterization that follows.

Lemma A.1. *There exists $\widetilde{\eta} \in (0,1)$ such that $w^*(\widetilde{\eta}) = 0$.*

Proof. Let $\eta = 1$. Then

$$p_g R - (1+\alpha)I + (1+\alpha-p_g)\eta I$$

collapses to $p_g(R-I) > 0$. On the other hand, if $\eta = 0$, it collapses to $p_g R - (1+\alpha)I < 0$. Last, because $1+\alpha-p_g > 0$, the expression is monotonically increasing in η, which completes the proof. ■

It is useful to state the following results:

Result A.2. *Borrowers with wealth $w \geq (1-\eta)I$ are fully collateralized.*

Result A.3. *Guarantees increase the bank's profit for any borrower it lends to.*

Result A.4. *For borrowers such that $w \geq w^*$, the bank appropriates all the additional surplus created by the guarantee.*

This result follows directly from the fact that the guarantee does not improve the outside option of the borrower.

Result A.5. *For borrowers such that $w^*(\eta) \leq w \leq w^*$, the bank appropriates all new surplus created by lending above the outside option.*

It is now simple (if tedious) to compute the change in the profit of lending to a borrower with illiquid wealth w. This is always equal to

$$\Delta_g(\eta,w) \equiv \pi_g(\eta,w) - \pi_g(0,w).$$

Some simple algebra yields the following. If $(1-\eta)I \geq w^*$, then

$$\Delta_g(\eta,w) = \begin{cases} (1-p_g)\eta I, & w \geq I \\ (1-p_g)\eta I + \alpha(I-w), & (1-\eta)I \leq w < I \\ (1-p_g)\eta I + \alpha\eta I, & w^* \leq w < (1-\eta)I \\ (1-p_g)\eta I + \alpha\eta I + [p_g R - u(w) - (1+\alpha)I + \alpha w], & w^*(\eta) \leq w < w^* \end{cases}$$

Clearly, in the relevant ranges

$$(1-p_g)\eta I + \alpha\eta I > (1-p_g)\eta I + \alpha(I-w) > (1-p_g)\eta I.$$

Moreover, $(1-\alpha-p_g)\eta I + [p_g R - u(w) - (1+\alpha)I + \alpha w]$ is increasing in $[w^*(\eta), w^*)$ and, because the term in brackets is negative, it reaches its maximum at w^*, where

$$(1+\alpha-p_g)\eta I + [p_g R - u(w^*) - (1+\alpha)I + \alpha w^*] = (1+\alpha-p_g)\eta I$$

(see Figure 1).

Now, assume $(1-\eta)I < w^*$. Then

$$\Delta_g(\eta, w) = \begin{cases} (1-p_g)\eta I, & w \geq I; \\ (1-p_g)\eta I + \alpha(I-w), & w^* \leq w < I; \\ (1-p_g)\eta I + [p_g R - u(w) - I], & (1-\eta)I \leq w < w^* \\ (1-p_g)\eta I + \alpha\eta I + [p_g R - u(w) - (1+\alpha)I + \alpha w], & w^*(\eta) \leq w < (1-\eta)I. \end{cases}$$

Clearly, in the relevant ranges

$$(1-p_g)\eta I + \alpha\eta I > (1-p_g)\eta I + \alpha(I-w);$$

and, again, $(1-\alpha-p_g)\eta I + [p_g R - u(w) - (1+\alpha)I + \alpha w]$ is increasing in $[w^*(\eta), w^*)$ and

$$(1+\alpha-p_g)\eta I + [p_g R - u(w^*) - (1+\alpha)I + \alpha w^*] = (1-p_g)\eta I + \alpha(I-w^*)$$

(see Figure 2).

A.2. Which borrowers receive a public guarantee?

Now if the bank wins an amount F from the goverment-guarantee program, and each borrower receives a guarantee ηI, then there is a clear pecking order. As can be seen from the figures, the bank's profit increases more with some borrowers than with others, and public guarantees will be allocated first to the ones with the highest $\Delta(\eta, w)$.

Small individual coverage rates Consider first the case when $(1-\eta)I \geq w^*$, i.e. the guarantee is small. Then the most profitable borrowers are such that $w^* \leq w < (1-\eta)I$, i. e. borrowers that receive credit without Fogape. There are $\mathcal{C}[(1-\eta)I] - \mathcal{C}(w^*)$ of these borrowers and the following result follows:

Result A.6. *If* $\eta I \times \{\mathcal{C}[(1-\eta)I] - \mathcal{C}(w^*)\} \leq F$, *then no new borrowers are financed.*

It follows that when the per-borrower public guarantee is small, additional credits are granted only if the public guarantee fund is large enough. As the guarantee fund grows in size, some redlined borrowers begin to receive credit.

Nevertheless, as can be seen from Figure 1, these borrowers compete with those who have enough illiquid wealth to become fully collateralized once they receive a public guarantee. Call $\underline{w}(F)$ the borrower with lowest illiquid wealth who receives a public guarantee, and $\overline{w}(F)$ the borrower with highest illiquid wealth who receives a public guarantee. Then

$$\Delta(\eta, \underline{w}(F)) = \Delta(\eta, \overline{w}(F))$$

for $F > \eta I \times \{\mathcal{C}[(1-\eta)I] - \mathcal{C}(w^*)\}$. $F > \eta I \times [\mathcal{C}(I) - \mathcal{C}(w^*)]$

Result A.7. *If* $F \geq \eta I \times \{\mathcal{C}[(1-\eta)I] - \mathcal{C}(w^*)\}$ *then*

Large individual coverage rates Consider now large individual coverage rates. As can be seen from Figure 2, large guarantees change the pecking order of borrowers. Now the largest profit increases occur for borrowers who are redlined. What is the intuition? In essence, when the individual coverage rate is large, even some borrowers with illiquid wealth $w < w^*$ will end up fully collateralized if they receive the public guarantee. And among fully collateralized borrowers, those with *less* illiquid wealth will be the (marginally) most profitable for the bank, because their outside option is worse. The following result is now straightforward:

Result A.8. *If the individual coverage rate is large and the public guarantee fund small, then only redlined borrowers receive a public guarantee.*

Figure 1
Guarantee allocation
with small individual public guarantees

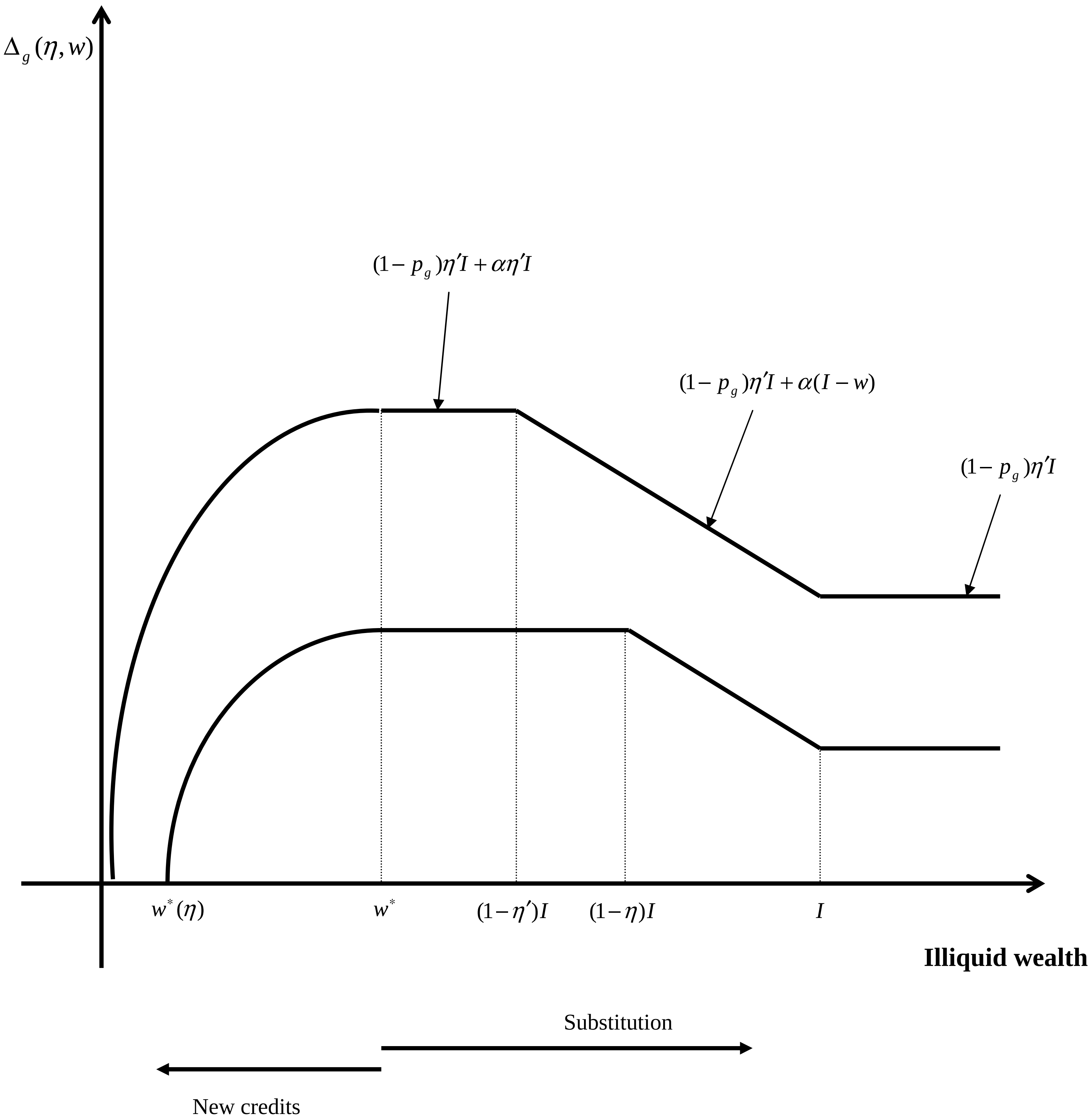

Figure 2
Guarantee allocation
with large individual public guarantees