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Risk Absorption by the State

When Is It Good Public Policy?

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Abstract

The global financial crisis brought public guarantees to the forefront of the policy debate. Based on a review of the theoretical foundations of public guarantees, this paper concludes that the commonly used justifications for public guarantees based solely on agency frictions (such as adverse selection or lack of collateral) and/or un-internalized externalities are flawed. When risk is *idiosyncratic*, it is highly unlikely that a case for guarantees can be made without risk aversion. When risk aversion is explicitly added to the picture, public guarantees may be justified by the state's natural advantage in dealing with collective action failures (providing public goods). The state can spread risk more finely across space and time because it can coordinate and pool atomistic agents that would otherwise not organize themselves to solve monitoring or commitment problems. Public guarantees may be transitory, until financial systems mature, or permanent, when risk is fat-tailed. In the case of aggregate (non-diversifiable) risk, permanent public guarantees may also be justified, but in this case the state adds value not by spreading risk but by coordinating agents. In addition to greater transparency in justifying public guarantees, the analysis calls for exploiting the natural complementarities between the state and the markets in bearing risk.

Risk Absorption by the State: When Is It Good Public Policy?

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1.   Introduction

The global financial crisis has brought public financial risk-bearing to the forefront. Governments came to the rescue of troubled financial markets and institutions through large risk-absorption-of-last-resort (RALR) operations involving outright asset purchases, capital injections and a relaxation of collateral requirements for liquidity support. Some governments also absorbed large losses from the risk positions they had implicitly taken through their developmental commitments prior to the crisis. This was the case in particular of the US government, which saw itself in the obligation to absorb the losses of Fannie Mae and Freddie Mac, the two large government-sponsored mortgage companies.

In Latin America and the Caribbean (LAC), this has reawakened contentious issues one thought had been finally settled. The region was moving away from public financial risk-bearing through the privatization of first-tier public banks and a refocusing of development banks towards second-tier lending, well-targeted guarantee programs, and temporary, catalytic developmental supports. However, development banks are now asking themselves whether they should grow bigger even in the good times, so as to play a more forceful role in the bad times. On the other hand, central bankers have become quite worried that their balance sheets (and hard-fought independence) might be compromised by political pressures to also play a more active RALR role.

In this context, interest in partial credit guarantee programs (PCGs) has surged. The expansion of such programs is viewed by some as a desirable middle ground to expand the risk-bearing role of the state while limiting the distortions resulting from its direct intervention in financial activities. However, the recent US experience has also been a useful reminder that public guarantees can be quite costly, in terms of both their potential fiscal costs and their impact on financial development and stability.

The concerns derived from the fiscal costs of public guarantees are compounded by the fact that the conceptual foundations of these programs are quite shaky. Guarantee programs are often justified based on social objectives. However, the rationale underlying the preference for state guarantees over other forms of public intervention is generally left unexplained. Alternatively, the need for state guarantees is based on the existence of market failures that need to be addressed.[2] The latter may be related to agency frictions (adverse selection, moral hazard, lack of collateral), or collective frictions (un-internalized externalities, free riding and coordination failures). Again, however, once a sufficiently broad welfare criterion is adopted (one that fully internalizes the fiscal cost of the guarantees and the way it is allocated among taxpayers), it becomes unclear why public guarantees can succeed where markets failed. If guarantees are called for, why can't private market participants fill up the gap? Similar questions seem to apply to nearly all forms of public financial risk bearing.

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[2] See, for instance, Jaffee and Russell (1976), Stiglitz and Weiss (1981), Mankiw (1986), Smith and Stutzer (1989), Bernanke and Gert (1990), Innes (1991), Benavente et al. (2006), and Arping et al. (2008. As discussed below, the papers that analyze government guarantees in a general equilibrium setting typically have focused on adverse selections problems and unanimously conclude that these problems do not justify guarantees (see Greenwald and Stiglitz, 1989; Gale, 1991; Williamson, 1994; Lacker, 1994; and Li, 1998).

Despite the world-wide popularity of public sector credit guarantees,[3] typically granted via national and multilateral development agencies and banks, the theoretical economics literature has devoted rather scant attention to the issue. As argued in this paper, Arrow and Lind (AL, 1970) remains as the most fundamental and enduring rationale for public sector guarantees, which hinges on risk aversion and the government's superior capacity to spread risk across space and time. Curiously, however, this seminal paper has been mostly ignored in scholarly work on public guarantees.

This paper contributes to the policy debate by setting the underpinnings of credit guarantees on a sounder theoretical footing. It analyzes the foundations of public risk-bearing from a finance paradigms perspective, using the conceptual framework developed in de la Torre and Ize (2010, 2011), which emphasizes the non-reducible, independent implications of four types of market failures, two of which (information asymmetry and enforcement costs) conform the agency paradigms, and the other two (collective action and collective cognition frictions) conform the collective paradigms. [4]

The paper reaches the five following broad conclusions. First, when risk is idiosyncratic (hence is ultimately diversifiable), risk aversion is the key required justification for all forms of guarantees, whether private or public. In the absence of risk aversion among lenders, it is highly unlikely that a case for guarantees can be made based on the traditional grounds of agency failures or externalities. Agency failures justify neither guarantees nor subsidies; externalities justify subsidies but not guarantees.

Second, the state can spread idiosyncratic risk more broadly than markets by coordinating and pooling atomistic agents that would otherwise not organize themselves to solve agency frictions. Agency (information or enforcement) frictions lead to risk concentration (reflecting the need for sufficient "skin in the game" to align principal-agent incentives) and thus get in the way of risk spreading. State guarantees may thus have an edge over private guarantees not because the state can better resolve the agency frictions but because it can better resolve the collective action frictions that undermine the market's ability to overcome the agency frictions.

Third, public guarantees can be justified on a transitory basis when financial systems are underdeveloped but as long as such guarantees aim at crowding in (rather than crowding out) the private sector. However, the permanent use of public guarantees may also be justified, even in mature financial systems, when the idiosyncratic risk is excessively fat-tailed.

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[3] As documented, for instance, in Honohan (2008) and Beck et al (2008).

[4] The framework developed in de la Torre and Ize (2010, 2011) considers four paradigms, labeled *costly enforcement* (CE), *collective action* (CA), *asymmetric information* (AI), and *collective cognition* (CC). Two of these paradigms (CE and AI) give rise to bilateral (agency) market failures while the other two (CA and CC) are associated with multilateral (social) market failures. At the same time, two paradigms (CE and CA) are founded on full information and full rationality while the other two (AI and CC) are based on informational and learning frictions, possibly leading to bounded rationality.

Fourth, the state can also put public guarantees to good use in the case of aggregate (non-diversifiable) risk, even in the absence of agency frictions.[5] This is because private individuals faced with endogenous risk and constrained by bargaining costs can fail to coordinate so as to behave in a way that is consistent with their collective interest. In this case, what matters is the coordinating (rather than risk spreading) ability of the state.

Fifth, going back to the mentioned basic principles should help in rethinking and reorganizing the role of the state in financial development. Greater transparency in explaining and justifying the role of the state is clearly called for. The comparative advantages of the state in resolving collective and of markets in resolving agency frictions suggest that the state and markets should naturally complement, rather than substitute for, or compete with, each other.

The rest of this paper is organized as follows. Section 2 deals with the case of pure agency frictions and no risk aversion. Section 3 adds collective action frictions but continues to assume away risk aversion. Section 4 combines risk aversion with pure agency frictions. Section 5 adds collective action frictions to the brew. Section 6 expands the discussion to the case of aggregate risk. Section 7 discusses policy implications and issues. Section 8 concludes.

2.   The case of pure agency frictions

Consider first the case of idiosyncratic risk and pure agency frictions, assuming for now that lenders lack risk aversion (i.e., that they are risk neutral) and that there are no collective action frictions (derived from externalities or coordination problems). As is well known in the literature, asymmetric information in credit markets, even without risk aversion, can lead to socially inefficient outcomes of under-lending or over-lending. For example, Jaffee and Russell (1976) and Stiglitz and Weiss (1981) demonstrate that asymmetric information can lead to adverse selection as higher interest rates attract riskier borrowers, which can result in under-lending as lenders may ration credit to a level that is below the socially desirable one.[6]

The appropriate policy response to these agency-driven market failures is not obvious, however. Most of the literature that finds that asymmetric information can justify state credit guarantees uses a partial equilibrium framework; that is, it does not consider the welfare effects of the taxes needed to finance the guarantees. Instead, the literature that uses a general equilibrium framework and applies an appropriately stringent welfare criterion (requiring revenue neutrality *and* taking into account the distributional implications of the taxes levied to finance the state guarantees) systematically concludes that, in the absence of risk aversion, state

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[5] *Aggregate* risk (also defined in the finance literature as *systematic* risk) refers to risk that affects all agents simultaneously within a given jurisdiction and is, therefore, non-diversifiable. Aggregate risk may or may not lead to *systemic* risk, where the entire financial system becomes affected and where risk may be compounded by agents' endogenous responses and interdependencies.

[6] Over-lending can also occur: when projects that would be equally profitable if successful have different success probabilities, low interest rates can induce borrowing under low success probabilities, even though their expected returns are below the social rate of return. See De Mezza and Webb (1987; 1999); and Beck and de la Torre (2006).

guarantees cannot improve the market outcome, except when the state has an informational or enforcement advantage over the private sector, which is, in general, hard to argue.[7]

To help understand what is at stake, consider the student loan model of Mankiw (1986). This model focuses on the information asymmetry problem of adverse selection and assumes that lenders are risk-neutral. Students' honesty varies over the population. However, the lender knows less than the borrowing student; specifically, he knows the mean of the distribution but not each individual student's characteristics. Moreover, reflecting enforcement and informational frictions, the lender cannot force repayment and must thus raise the interest rate on all loans to cover the losses on the unpaid loans. But, by raising the price of all loans, the dishonest (those who do not intend to repay) prevent the honest (those committed to repaying) from borrowing. Because it would have been socially desirable for the honest to borrow, society is worse off.

What can policy do about this? To answer this question, notice first that, in the absence of risk aversion, an unsubsidized guarantee (that is, a guarantee priced to cover expected losses) has no impact. While it reduces risk, this is of no consequence to a risk-neutral lender. The price of the guarantee matches the cost of the loan loss provisions that the lender would have to incur in the absence of the guarantee. As a result, the fairly priced guarantee adds no value and, hence, will not affect the lender's behavior.

By contrast, if the state provides a fully subsidized credit guarantee (a 100 percent default guarantee with a price equal to zero) the risk-neutral lender saves the cost of loan loss provisions and is thereby induced to lend to all students at the risk-free interest rate. From a partial equilibrium viewpoint, absent a requirement of revenue neutrality, the subsidized guarantee would, therefore, allow the social optimum to be reached. However, from a more stringent (and generally warranted) welfare perspective, the financing of the guarantee and the distribution of tax payments across the student population also matter. Unless the students who default also pay the tax, taxing only the nondefaulting students would make them worse off because they would end up paying for the defaulting students (see the proof in Appendix I). Thus, although a subsidized guarantee could be socially justified, the nondefaulting, tax-paying students (including those who would not borrow without the guarantee) would prefer to go without it.

Clearly, taxing only the defaulting students would lead to a Pareto improvement. But doing so amounts to assuming that one can enforce taxation where one cannot enforce a loan repayment. The optimality of the (subsidized) guarantee in a Mankiw-type student loan model of adverse selection hinges, therefore, exclusively on a *differential enforcement capacity*. This does

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[7] The partial equilibrium literature that does not require revenue neutrality finds that state guarantees can improve things by increasing credit (e.g., Mankiw 1986; Smith and Stutzer 1989; Innes 1991; Benavente, Galetovic, and Sanhuenza 2006; Arping, Loranth, and Morrison 2010). The literature that takes a general equilibrium view (and hence imposes revenue neutrality) can be classified into two groups. The first group uses a Kaldor-Hicks welfare criterion that simply looks at the total size of the pie but not at its distribution across the population. With such a criterion, some papers predict that state guarantees can lead to an improved equilibrium (e.g., Ordover and Weiss 1981; Bernanke and Gertler 1990; Innes 1992; and Athreya, Tam, and Young 2010). However, others do not (e.g., Li 1998; Gale 1991; Williamson 1994). The second group of papers incorporates the welfare impacts of tax redistribution. The papers in this latter group (for instance, Greenwald and Stiglitz 1989; Lacker 1994) uniformly conclude that, without an informational advantage and the ability to cross-subsidize, it is not possible for state guarantees to produce a Pareto improvement.

not make sense in a political system where the rule of law applies to states as well as to citizens. Any preferential loan collection capacity states may have should be made readily available to everyone through improving the judiciary, as part of a more supportive enabling environment. For similar reasons, a private agent might consider offering his screening services to the lender if he was better informed (hence better able to discriminate between the good loans and the bad loans) or better able to collect (hence make the dishonest pay for their sins). However, an agent with such capabilities (for example, one who is able to benefit from economies of scale in putting together an effective sorting system for borrowers) would be in the business of selling services to banks, not in guaranteeing their loans.

Broadly similar arguments can be developed when, instead of adverse selection, the problem underlying the failure of risk-neutral creditors to lend to honest students is one of enforcement. Suppose, for example, that borrowers cannot obtain a loan because they lack good collateral and hence cannot credibly commit to repaying the loan. In this case, viable student borrowers without collateral would be excluded from the loan market, resulting again in a socially inefficient equilibrium. By replacing the missing collateral, it is often argued, a state guarantee could bring such borrowers back into the market. The problem with this argument is that, absent any change in the students' own "skin in the game," they would confront the same commitment-to-repay problem. Thus, unless the guarantee is fairly priced (so as to cover the expected loan losses and other costs) the loan default losses would simply be shifted to the state (the guarantor). But if the guarantee is fairly priced, risk-neutral lenders would not pay for it because, by definition, they care only about expected losses and not about the variance of such losses. Unless the state has an enforcement advantage vis-à-vis private lenders—which, as we already argued, is hard to justify—there is no case for a state guarantee.

The discussion in this section can be summarized as follows. In a world devoid of risk aversion and collective action frictions, agency frictions alone do not in general justify guarantees under a general equilibrium viewpoint that uses an appropriately restrictive welfare criterion. While the market outcome would be inefficient, a state that does not know more or enforce better than the private sector is unlikely to improve the outcome via credit guarantees. Indeed, one would generally expect the state to have a comparative disadvantage in dealing with pure agency frictions rather than an advantage. If the state had a comparative advantage in this regard, the right policy would be only to have state-owned and state-run banks, which patently makes no sense.[8] More generally, in a world where distortions arise only from agency frictions, while the market equilibrium is inefficient, the state is unlikely to improve on it by assuming risk, because there is no wedge between private and social interests—principals and agents want the same thing that society wants, namely, to overcome agency frictions and engage in mutually beneficial financial contracts. The only legitimate role left for the state in such a world is to improve the informational and enforcement environment so that markets can operate better.

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[8] Notice however that multilateral development banks (MDBs) that lend to public sectors to finance investment projects may enjoy informational advantages vis-à-vis private lenders, such as knowing more than private lenders about state processes and procedures. This may justify MDB guarantees even in a world characterized by pure agency failures with no risk aversion.

3.   Adding collective action frictions

Let us now add collective action frictions that manifest themselves in the form of *social* externalities—for example, positive externalities to lending that are not internalized by the private lender. However, we continue to assume that risk is idiosyncratic and lenders risk-neutral. The literature generally concludes that, in the absence of information asymmetries, any credit policy, including guarantees, is ineffective in improving the equilibrium outcome unless subsidized.[9] Indeed, subsidies and taxes are generally shown to be the best policy responses to a market failure arising from un-internalized externalities. However, the literature concludes that it becomes significantly more difficult to design optimal subsidies where externalities and asymmetric information coexist.[10]

To see what is at stake, notice first that in the Mankiw (1986) model of pure agency frictions the dishonest inflict negative *informational* externalities on the honest. However, barring differential taxation or enforcement capacity, there is no way for the state to internalize such externalities. *There is no collective action failure.* The dishonest are simply getting away with mischief. Even if bargaining were costless, it would not pay for the honest to buy out the dishonest. Indeed, using the same reasoning as in the previous section, the honest would have to make a transfer payment to the dishonest that exactly matches the tax payments that would be required to cover a subsidized state guarantee or an interest rate subsidy. Similarly, even though it seems obvious that one should lend to every student whose return exceeds the social cost of funds, a state banker without an informational or enforcement advantage should not lend and behave exactly like a private banker.

How would adding social externalities and collective action frictions change this conclusion? Suppose lending to some targeted students (say, the ones studying to become primary school teachers) has positive social externalities (e.g., a good basic education enhances the earning potential from college education in all fields of study). The market outcome would be inefficient even if private lenders could solve agency problems and properly identify all the creditworthy students. Private lenders, by pricing all loans uniformly, would fail to lend sufficiently to students planning to be primary school teachers because their earnings prospects are mediocre, even though those students can contribute the most to other students' earnings. The private lender does not internalize the externality. There is now a clear case of a *collective action* failure. Should students of all generations and in all fields of study be able to get together, bargain an agreement and enforce it at no cost, they would agree on setting aside part of the increase in their future earnings resulting from a better primary education in order to subsidize the interest rates on the loans to future primary school teachers.

However, in the presence of collective action frictions, students will not be able to coordinate their actions to ensure a socially beneficial outcome. Instead, where wage subsidies to school teachers are not an available option, the state can resolve this externalities-driven market failure by coordinating agents through an interest rate subsidy program favoring loans to the would-be teachers and paid for by all other students. Since informational frictions require that

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[9] See, for example, Raith, Staak, and Starke (2006), Penner and Silber (1973) and Lombra and Wasylenko (1984).

[10] See Stiglitz, Vallejo, and Park (1993), Calomiris and Himmelberg (1994), and Bhattacharya (1997).

bankers screen potential borrowers and monitor their performance, and since such efforts are costly, targeted interest rate subsidies dominate targeted and subsidized guarantees. While both policy instruments can similarly expand the level of targeted lending, the interest rate subsidy is preferable because it is less likely to distort the lender's screening and monitoring incentives (the lender retains "full skin in the game"). This illustrates that, as long as there is no risk aversion, collective action frictions alone can establish a good case for tax and subsidy policy but not for state credit guarantees.

But there might also be cases where the state's cost of monitoring whether private lenders appropriately screen loan applicants according to the social criteria it set forth is greater than the cost of simply setting up a first-tier state bank that directly provides the subsidized loans.[11] In such cases, the assumption by the state of the risks associated with financial activities can be justified on the basis of the state's capacity to address agency frictions (that is, ensuring that the loans are given to the most socially desirable borrowers). However, it is crucial to note that such agency frictions arise out of an underlying collective action failure that prevents markets from internalizing externalities.

The bottom line for this section is, therefore, as follows. When social externalities and collective action frictions are added to agency frictions in a world devoid of risk aversion, the case for state intervention becomes clear, but it is hardly in the form of credit guarantees. When these frictions are relatively light, the state might limit its intervention to that of a catalyst that brings together all interested parties and facilitates the transfers across parties required for a mutually beneficial equilibrium. When the frictions are harder to overcome, the state can circumvent them through a targeted tax-subsidy program, which internalizes externalities. However, the implementation of this program may run into agency frictions. Thus, depending on whether the state or the markets can better address these latter frictions, it might be optimal for the state to subsidize the loans provided by private lenders or to provide the loans directly through a first-tier state bank. Remarkably, however, the basic motivation underlying the state's intervention is always the need to address collective frictions, which introduce a wedge between private and social interests that markets cannot resolve on their own.

4.   Adding risk aversion to agency frictions

Let us now add risk aversion among private lenders while reverting to the case of pure agency frictions (that is, assuming the absence of collective action frictions). Arrow and Lind (AL 1970) remains the most fundamental and enduring conceptual framework for understanding the role of the state in bearing risk when there is risk aversion. AL first show that, when risk is spread in small amounts over large numbers of investors, capital can be priced at risk-neutral prices. They then argue that the state's inter-temporal tax and borrowing capacity gives it a unique ability to spread risk across large populations. Thus, state guarantees (as opposed to subsidies or loans) are naturally called for to reduce the cost of risk bearing and to encourage private investment or lending in the face of high risk or high risk aversion.

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[11] The argument that the state may be able to provide incentives to public lenders more easily than to private ones is in line with Holmstrom and Milgrom's (1991) result that increasing the incentives along a measurable performance dimension (costs or profitability) reduces the incentives along nonmeasurable dimensions. For a fuller discussion along these lines of the role of first-tier public banks, see also IDB (2005).

Curiously, the literature on partial credit guarantees (PCGs) has mostly ignored the AL perspective. In the scant literature on this subject, a dominant theme is a rebuttal of the proposition that there is anything unique in the state's capacity to spread risk. For example, Klein (1996) argues that if the state's advantage did not lie purely in its coercive taxation powers (that is, its capacity to oblige taxpayers to bear unwanted risk through the tax system), then markets would be able to spread risk just as efficiently. But as AL themselves suggest, it may not be possible for the private sector to be completely risk-neutral, even when risk is spread through broad ownership. Since the controlling shareholders of a firm need to hold large blocks of stock and such holdings are likely to be a significant portion of their wealth, the costs of risk bearing are not negligible and the firm should behave as a risk averter. Thus, although AL hints at the existence of a link between risk aversion and agency problems (adequate monitoring implies large stake exposures), they do not develop it, nor has the literature picked up on that theme.

To help analyze whether there is indeed something unique about the state's risk-bearing capacity, we introduce risk aversion into the well-known monitoring model of Calomiris and Khan (1989). An entrepreneur funds a risky project through a mix of retail and wholesale funding. Projects that are doomed to fail can be liquidated—thereby salvaging some of their value—if they are so identified at an early stage through monitoring. Retail investors do not monitor because they have too small a stake in the project relative to the cost of monitoring. Instead, wholesalers can engage in monitoring because they can recoup their investments in failing projects. However, they will only do so only if they have sufficiently large stakes in the project (sufficient "skin in the game") to warrant incurring the monitoring costs. In the absence of risk aversion (the case analyzed by Calomiris and Khan), wholesalers do not need to be paid a risk premium to bear such risk. Hence, it is not socially costly for them to retain "skin in the game." Entrepreneurs can therefore contract enough wholesale funding to allow wholesalers to fully recoup the cost of the socially efficient level of monitoring. An efficient equilibrium is therefore obtained where monitoring costs can be absorbed *without having to spread any risk*.[12]

But suppose now that wholesalers are risk-averse. Having "skin in the game" raises the cost of wholesale funds, resulting in an inefficient equilibrium with insufficient wholesale funding, hence insufficient monitoring. A guarantor buying the risk that is concentrated in wholesalers and spreading it by reselling it in small amounts to retailers could therefore improve in principle the market equilibrium. In doing so, however, the guarantor faces and must solve three interrelated problems. First, since monitoring is costly, the guarantee undermines wholesalers' incentives to monitor the entrepreneur and his project. This is the standard moral hazard problem of insurance markets. To avoid distorting wholesalers' monitoring incentives, the guarantor can monitor wholesalers and adjust the premium of the guarantee according to how well they perform their monitoring. However, monitoring the monitor also has a cost. Second, the guarantor's capacity to resell the risk to retailers will itself depend on his capacity to convince them that he is doing a good job himself at monitoring wholesalers and, hence, is offering retailers a fairly priced risk-sharing deal. Retailers need therefore to be able to monitor the guarantor's own monitoring efforts. But this again has a cost. Third, in order to spread risk

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[12] This is indeed the main result in Calomiris-Khan. However, Huang and Ratnovsky (2011) challenge this result by showing that in the presence of noisy public information, wholesalers may have an incentive to free ride on this information and run early when needed rather than to monitor.

over a sufficiently large base, guarantors need to have a sufficiently broad clientele. However, even in the absence of informational frictions, retailers' participation may be limited due to un-internalized externalities (i.e., individuals' failure to take into account that the social benefits of their participation exceed the individual net benefits) and other collective action frictions. In this section, we assume away such collective action frictions (we come back to them in the next section) and focus exclusively on informational frictions.

Suppose that the guarantor finds an efficient way of monitoring wholesalers (and can include monitoring costs in the guarantee price). Can the guarantor then convince those to whom he tries to sell risk that he is doing a good monitoring job? Because it is in the guarantor's own interest to have his monitoring certified (he will not be able to sell risk otherwise), and because they can include the certification cost in the price of their guarantee, guarantors can pay someone (say, a rating agency) to do the certification. However, this pushes the monitoring pyramid up one more layer, as retailers, in turn, need to be convinced that the rating agency has done a good job certifying guarantors. If monitoring the rating agencies could be done without cost, this would solve the problem. But this would in practice not be a trivial task and would likely involve costs. The potential conflicts of interest between bond issuers and rating agencies that have emerged at the heart of the post-crisis debate on regulatory reform are testimony to the difficulty of solving this problem.

However, in the absence of participation and other collective action frictions, market arrangements to monitor the rating agencies should spring up, the costs being added to the other monitoring costs incurred at other levels of the monitoring pyramid. The compounded costs of monitoring should thus ultimately be factored in the price of the guarantee, to be paid by wholesalers as part of the insurance premium. Nonetheless, for *risk to be fully spreadable* (hence for full guarantees to restore the first best, fully efficient equilibrium), these compounded monitoring costs should be lower than the benefits of monitoring (the gains from early project liquidations). At the same time, the costs of monitoring the monitor should be lower than the costs that wholesalers' would otherwise have to incur in directly monitoring the project (i.e., the borrowers). Hence, there should be efficiency gains as one goes up the monitoring pyramid (see the proofs in Appendix II). There is, therefore, a fundamental positive correspondence between the market's capacity to spread risk through guarantees and its capacity to limit monitoring costs through an effective monitoring pyramid.

Remarkably, however, these monitoring costs do not depend on whether the state or the markets provide the guarantees. A state guarantor will face exactly the same monitoring problems and constraints as a private guarantor. Indeed, a good argument can be made that private guarantors should generally be better at dealing with informational frictions than public guarantors. Thus, in the absence of participation and other collective action frictions, private guarantors should naturally emerge, leaving no role for public guarantees. The only likely role for the state would be to strengthen the enabling environment so as to help alleviate the informational (or enforcement) frictions that hinder risk spreading by the private sector.

The argument in this section can thus be summarized as follows. Unless risk is properly spread out, risk aversion, combined with agency frictions, introduce a deadweight cost that constitutes a first source of market inefficiency. A guarantee may thus lower the cost of capital

by spreading risk more broadly. However, the guarantee introduces moral hazard, a second source of market inefficiency. Hence, to fully spread risk (through full, one hundred percent guarantees) without introducing incentive distortions, it is critically important that the monitoring pyramid be sufficiently efficient. If the costs of monitoring the monitor are sufficiently low, the market solution can replicate the optimal solution by replacing a socially costly "skin-in-the-game" requirement for good monitoring by a more efficient (cheaper) pyramidal market monitoring arrangement with full risk spreading. In the absence of substantial collective action frictions, the guarantees are likely to be provided more effectively by markets than by the state.

5.   Combining collective action frictions, agency frictions, and risk aversion

Let us now add back collective action frictions to the brew, so that we now have the simultaneous presence of agency frictions, collective action frictions, and risk aversion. Even if all information frictions are resolved, the guarantor needs to pool a sufficient number of retailers to underwrite the guarantee. This may require *solving market participation frictions*. In view of the atomicity of their investments, absent a market architecture that allows for pooling, retailers may not bother to participate. While it would be socially desirable for them to participate in the risk market so as to spread risk efficiently, individual retailers may not internalize this positive participation externality.[13] Instead, the participation disincentives faced by retailers may require the guarantor to incur costs (for example, in advertising) in order to attract investors.

In a well-developed financial system, the guarantor would not have to deal directly with retailers. Instead, an additional layer of agents—the asset managers (mutual funds, pension funds, hedge funds, and the like)—could pool retail investors for the guarantor, thereby reducing the costs of participation. But in an undeveloped financial system, the costs of mobilizing participation will be higher, so that adding them to the guarantor's certification costs might well raise total costs to a point where the guarantee is no longer viable. Thus, the ability of the guarantor to unload risk will very much depend on how well-developed financial markets are. In mature financial systems, the market can resolve participation frictions through a deep network of asset managers. In an undeveloped system, such frictions remain unresolved.

This is precisely where the state can help to complete markets. A state guarantor can spread risk without having to market it (the risk distribution is taken care of through well-established frameworks for taxation and public decision-making) and can, therefore, effectively resolve participation failures. Thus, there is a clear infant industry argument for *transitory* state guarantees when financial systems suffer from low participation (low financial inclusion). In addition, the state may need to help close the monitoring pyramid. With collective action frictions, the necessary arrangements to monitor rating agencies may not spring up by themselves. Closing the monitoring pyramid may require the provision of a public good in the form of official oversight over the market monitors.

If idiosyncratic risk is fat-tailed, state guarantees may also be justified on a more *permanent* basis, because even the more developed financial markets may not be able to reach

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[13] Participation externalities occur when the gains in participating in an activity depend on the number of other agents participating as well (see Diamond, 1982; and Pagano, 1989). By hindering coordination, participation frictions prevent agents from internalizing such externalities.

the scale of participation needed to atomize and distribute the risk sufficiently.[14] State guarantees can spread the risk all the more finely because they can do so across currently living taxpayers and across generations within a given jurisdiction. However, even in the case of intergenerational risk spreading, the state sector's advantage derives again from its capacity to address a collective action (participation) friction, rather than an enforcement (agency) friction.[15] Indeed, trying to depict the inability of markets to contract across generations from a pure enforcement perspective is rather futile. Since it is not possible to write bilateral contracts with someone unborn, "enforcing" such contracts is meaningless. Instead, the state has an edge because of the intergenerational burden sharing that the political system is naturally designed to achieve.[16]

In sum, the risk spreading ability of the state and, hence, the rationale for state guarantees ultimately rest on the comparative advantage of the state in resolving collective action frictions, *which is the traditional justification for public goods*. State guarantees may have an edge over private guarantees not because the state can better resolve agency frictions but because collective action frictions may disable the market's ability to resolve such agency frictions. Where private lenders are risk-averse, and even where risks are idiosyncratic and therefore diversifiable in principle, the state can spread the risk more broadly than the market by resolving participation externalities—that is, the state can pool atomistic investors (or taxpayers) that would otherwise not participate in underwriting the guarantee. Taxation should thus be viewed not as a device to force unwilling taxpayers to share risks (as in Klein 1996), but rather as a simple, built-in coordination mechanism that facilitates the participation of all. However, for state guarantees to be desirable, it is critically important that their adverse impact on monitoring and enforcement incentives be limited.

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[14] In principle, the AL argument continues to apply: no matter how lumpy the risk, it can still be distributed atomistically, provided there are enough retailers over which the risk can be spread. In AL, the number of retailers can go all the way to infinity. In practice, however, there is an important difference between a large number and an infinite number. Moreover, and perhaps more importantly, participation frictions limit market depth even in well-developed financial systems. Thus, the number of retailers over which risk can be spread, even if large, may not be sufficient. That is why there may be a point at which a permanent public guarantee may be needed, even in mature systems, to bound the risk associated with unpredictable returns or where there is some probability, even if very small, of very large losses. Knightian uncertainty—when decision makers cannot determine the probabilities of events (see Epstein, 1999)—is likely to have an effect similar to fat tails. The more uncertain the risk, the more finely it needs to be distributed, which, in principle, makes more of a case for public guarantees.

[15] There may be one exception, however, in which the public sector may have a genuine advantage in dealing with agency frictions. Lenders and entrepreneurs may deal with each other on the basis of proprietary information and relationship lending. While private guarantors need to access this information to understand the risks, the lenders involved in these private deals may be reluctant to share the information since they might lose proprietary rents when the information is leaked. In this case, a public guarantor could have an edge because it might, arguably, be less likely to leak the information. Be as it may, such advantages, if they exist, should gradually vanish as financial systems mature and information becomes increasingly public.

[16] Enforcement frictions (the other important type of agency frictions) may also help justify the need for public guarantees but, as with informational frictions, not because the state has any natural advantage in enforcing contracts. As already noted in Section 2, there is no credible reason why enforcement failures can be resolved through the state's uncontested ability to tax but not through well-formulated private contracts and a well-functioning judiciary. Instead, the state may have an edge because costly contract enforcement is likely to require cost sharing, which again faces a collective action problem that the state can resolve more successfully than markets. In turn, taxation should not be viewed (as in Klein 1996) as a mechanism to oblige unwilling taxpayers to share risks, but instead as a simple, built-in coordination mechanism that facilitates the participation of all.

6.   Aggregate risk

Consider finally the case of aggregate (non-diversifiable) risk. State guarantees can be justified on a permanent basis in the presence of non-diversifiable risk, including that which is endogenously brewed in the process of financial development itself. The rationale in this case, however, no longer derives from risk spreading but rather from the state's capacity to help coordinate agents' actions around an efficient risk-sharing equilibrium.

Aggregate risk has three main threads. First, it is likely to be correlated with consumption, wealth, and income. As a result, the risk-spreading argument in AL no longer holds, and agents may require a significant risk premium to bear risk. Second, aggregate risk may become endogenous and prone to multiple equilibria, turning into *systemic* risk, as in the typical bank run setting of Diamond and Dybvig (1983). Finally, aggregate shocks may be associated with extreme uncertainty, inducing agents to abandon altogether the expected utility-maximizing framework and to choose instead a min-max criterion such that they minimize their exposure to the maximum possible loss. In the latter case, the choices made by individual agents may cease to be fully rational, as each agent can behave as if he was affected more than the average.[17] In all of these cases, risk is non-diversifiable and the AL risk-spreading argument no longer holds. In particular, when risk is endogenous or agents abandon the expected utility framework due to uncertainty, the total cost of risk bearing remains the same even as the population of taxpayers becomes large, making risk non-diversifiable. Similarly, because correlated risk applies to an investor deciding whether to invest in a private guarantee scheme as much as to a taxpayer deciding whether to vote for a state guarantee scheme, the state no longer has a natural risk-neutrality advantage.

However, state guarantees are still useful in the case of aggregate risk because they help resolve collective action failures. For instance, when agents minimize their exposure to a worst-case risk scenario (which leads to a socially inefficient equilibrium compared to the case where agents behave in view of the average risk), the state can be in some sense more rational than the agents it represents. By eliminating such a scenario, state guarantees effectively function as a coordination device, much as deposit guarantees and lender-of-last-resort facilities can eliminate self-fulfilling bank runs. In the case of correlated risk, state guarantees can still improve things by helping avert the collective action failures that magnify the impact of a systemic event. By coordinating agents' behavior around a collectively desirable outcome, state guarantees help reduce the risk of catastrophic downturns, thereby smoothing out private consumption, which, in turn, helps reduce the costs associated with risk aversion and lowers the required risk premium.

7.   Toward a rebalanced policy

The main message from the above conceptual analysis is that the state should play to its strengths—helping resolve collective action failures—rather than its weaknesses—dealing with agency frictions. This implies that the state should seek to complement (rather than substitute

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[17] See Diamond and Dybvig (1983) and the more novel contributions of Caballero and Krishnamurthy (2008) and Caballero and Kurlat (2009) on the role of public guarantees under uncertainty. More generally, one could also argue that the state could behave collectively in a more rational way than individuals when the latter are subjected to systematic behavioral biases.

for) markets, crowding in the private sector and harnessing its comparative advantage in dealing with agency problems rather than crowding it out.

This opens three broad avenues to explore. The first, the least controversial, comprises policy interventions exclusively geared at solving participation frictions—both along the intensive margin (the same players engaged in more transactions) and the extensive margin (the incorporation of new players)—*without dealing directly with risk*. Rising financial inclusion makes it easier for the financial services industry to lower costs as well as to expand market liquidity and other positive spillovers associated with scale and network effects, thereby ultimately helping diversify risk. This justifies the state's catalytic roles portrayed in the previous section. But it can also explain the establishment and operation by central banks of large-value payments systems, the promotion by the state sector of clearing, settlement, and trading infrastructures, or the spearheading by the state of the standardization of contracts. It can also justify mandated—or gently coerced—participation, as in the case of the payment of state employee wages through accounts in banks that participate in a shared, open-architecture platform for retail payments. Alternatively, the creation of mandatory but privately administered pension funds can help promote the development of annuities (as in Chile), which in turn can help develop a market for spreading the risk associated with long-term instruments. Given the presence of positive externalities, the state can also use well-targeted subsidies as part of these interventions.

The second avenue deals with risk by promoting private sector risk-spreading. This can be done through catalytic efforts or compulsory schemes. As an example of the first type, the state can promote, without taking risk, private sector participation in guarantee schemes, such as mutual guarantee associations funded by small local entrepreneurs, or guarantee schemes structured as joint stock companies with private participation. The experience across the world with such schemes has been generally positive, partly because they promote peer pressure, a purely private form of resolving collective frictions. Indeed, there is some evidence that such associations work best when they remain purely private, as this fully preserves incentives for group monitoring and limits moral hazard.[18] As an example of the second type (compulsory risk-sharing arrangements), the state can mandate the participation in automobile or health insurance schemes.

Clearly, the first two avenues above should be explored and exploited as a matter of priority. However, improvements in the enabling environment may not suffice. Nor might peer pressure or compulsory participation work in all cases and all environments. Thus, the third avenue, more controversial and thorny, involves risk absorption and risk spreading by the state, often through second-tier state banks, whether through guarantees or long-term loans.[19] In either case, it is the interaction of risk aversion, agency (monitoring) frictions, and participation

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[18] On the experience of mutual guarantee associations in Europe see Columba, Gambacorta and Mistrulli (2009). Lebanon provides an interesting example of a seemingly successful and profitable guarantee scheme structured as a joint stock company.

[19] A long-term finance commitment can be viewed as a funding (liability) guarantee that provides protection against liquidity risk and price volatility, instead of credit default. Thus, instead of the development bank actually funding the commercial bank, an equivalent arrangement would be for the development bank to provide swap and lender-of-last-resort facilities.

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frictions, together with the superior capacity of the state to resolve entrenched collective action problems, which justifies state insurance, even where risk is idiosyncratic (hence diversifiable). As noted, state guarantees may be temporary—a strictly developmental tool aimed at facilitating risk discovery and circumventing transitional collective action frictions—or permanent (in the face of fat-tailed or aggregate risk).

However, typically state-sponsored credit guarantee programs that are developmentally oriented do not seem to be, at first glance, fully consistent with such first principles. They seem to be permanent rather than transitory and they tend to target well-defined, recurrent, limited risks instead of insufficiently understood risks or tail risks where the state's comparative advantage in risk bearing and spreading could be more fully exploited. Moreover, these guarantee programs are typically justified based on asymmetric information, lack of collateral, or externalities instead of risk aversion. What explains these apparent disconnects?

Political economy offers one explanation. Correcting agency problems that hinder, for instance, SME lending (presumably ripe with positive social externalities) and lending to the lower-income households (presumably ripe with equity benefits if not externalities) sells better in the polity than correcting problems of risk spreading and differential risk aversion. In addition, it is not popular for the state to take on risk from private banks, even when doing so is fairly priced, because it smacks of a bailout. Moreover, if the aim is strictly risk spreading, where should a risk-neutral state draw the line? Should the state sector reinsure or guarantee all productive lending at the risk frontier, not just financing to SMEs? Should state guarantees apply to all long-maturity loans, irrespective of firm size? Expanding the risk frontier across the board is naturally unpalatable to politicians insofar as they are held accountable. Indeed, over the years, parliaments in LAC and many other regions have strictly limited risk taking by state banks. Moreover, state bank managers are naturally risk-averse. They protect their capital because they know that they will live or die with it.[20] And as already noted, the constraints that development banks face in terms of avoiding losses often induce them to compete with commercial banks in order to reap high returns for low risks, rather than—as the risk-aversion rationale would suggest—to complement private activity by insuring risk taking at the frontier.

Instead, state guarantees to SMEs or to target clienteles, such as those reached through low-income housing or student loans programs, look like safe bets when they are well within the risk frontier. They appear to pay for themselves (hence are fiscally safe) when well priced and designed.[21] Moreover, early research seems to indicate that partial credit guarantees supplied by states do provide at least some additionality.[22] Why, then, not safely collect the low-hanging fruit instead of shooting for the moon? This preference for seemingly low-risk/high-political-return programs has been accentuated over the last decade or two in LAC and other regions, especially in the context of mediocre growth, high structural unemployment, and tight fiscal constraints.

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[20] Development banks in Mexico, for instance, are regulated and supervised on par with commercial banks and are required by law to preserve the real value of their capital.

[21] See Honohan (2008) and Beck, Klapper, and Mendoza (2010).

[22] See Larrain and Quiroz (2006), Haines, Madill, and Riding (2007), and Arvai, Rocha, and Saadani (2011).

Lending or credit guarantee programs to those most affected by economic hardship have provided a convenient safety valve to relieve some of the build-up in political pressure.[23]

But the tendency of development banks not to move too aggressively towards the risk frontier reflects not just the political economy. It also reflects legitimate difficulties, particularly with the accurate pricing of guarantees. As noted, state guarantees are welfare-enhancing only as long and as far as all risks and the incentive distortions caused by state guarantees have been properly recognized and priced in. However risks at the frontier are not well understood and they may be abnormally distributed, with fatter tails. Under such circumstances, the pricing of guarantees becomes inherently difficult, as the estimation of expected losses and the decomposing of risk premia are subject to much error. Indeed, there are chilling cases of major failures and losses in ambitious state insurance programs that have aggressively aimed at crowding in the private sector towards the risk frontier. In part, such failures have reflected a misjudgment of expected losses.

Where does all of this leave us? First, it is time for state lending and insurance programs to come clean as regards their rationale and the minimal conditions for success. Instead of justifying state loan and guarantee programs based on goals, as is so often the case and with which it is so hard to disagree, policy makers need to focus instead on *alternative means of achieving these goals*. Thus, state risk-bearing programs should be justified by comparing their costs and benefits to those of alternative channels of state intervention that do not involve any state risk taking. Where guarantee programs are deemed appropriate, the programs' objectives, mandates, and reporting and disclosure requirements need to be refocused around a risk-aversion and risk-spreading rationale, more clearly linked to the agency or collective action frictions with which risk aversion interacts. They also need to explain why the state can achieve that which markets cannot. Either these programs are really self-sustaining and therefore should be eventually divested to the private sector, or there are complex or hidden risks (fat-tailed or systemic) that free markets cannot handle well and that need to be explicitly recognized and accounted for. Unless this is done right and state guarantees are reasonably priced, state guarantees will likely end up unduly subsidizing risk-taking, and this is bound to distort incentives and trigger unpleasant fiscal surprises (as well as political upheavals) once downsides materialize (the recent U.S. experience in the subprime crisis is, of course, the most obvious illustration).

It is, thus, not enough that state guarantee programs break even in good times. Break-even conditions should be evaluated through the cycle, i.e., considering longer-term trends. If priced right, these programs should accumulate reserves in the good times against potential losses in the bad times. For tail risk, this implies charging for the full expected value of the tail losses. One possible approach to facilitate risk discovery is to auction the guarantees according to their coverage or price.[24] By setting volumes rather than prices, guarantors can better protect themselves against the risk of major mispricing. At the same time, volumes may be adjusted to meet countercyclical objectives. They can be raised in systemic downturns when upward jumps

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[23] See Rajan (2010).

[24] This is the approach followed in Chile by FOGAPE. See Benavente, Galetovic and Sanhueza (2006) and de la Torre, Gozzi, and Schmukler (2007c).

in private risk aversion are more likely to trigger coordination failures and reduced in upturns when risk appetite can swell, fueling excessive credit expansion. To avoid head-to-head competition with the private sector in providing primary insurance, the state sector should prefer to provide its support through well-targeted reinsurance against tail risks.

As financial systems mature—and hence more information to assess and price risk becomes available—state loan and guarantee programs can be better targeted. For example, when risk scoring methods are available, fairly-priced state guarantees can be targeted to be at, or just outside, the risk frontier, so as to ensure that finance reaches clients and projects that are too risky for private institutions to lend without guarantees. When loans are made directly by first-tier public banks, making sure the interest rates on the loans are above market rates can help ensure that public risk bearing does not crowd out private risk bearing.[25]

The farther one seeks to move away from the private risk frontier, the more caution is of course called for. However, risk taking can be bounded and state governance protected in a variety of ways. For example, earmarked capital for specific insurance or countercyclical risk absorption can help state banks assume more risk in a responsible, bounded manner while protecting their capital from depletion. Alternatively, to align incentives, state banks can assume a limited part of the risk, the rest being covered by the state through earmarked capital or other means. Private-state partnerships in which the state assumes most (but not all) of the risk at a fair price may help facilitate price and risk discovery. Enhanced transparency, better measurement of risk and returns, and more sophisticated checks and balances (for example through recurrent assessments by independent evaluation units or occasional, more strategic reviews by blue-ribbon committees) should also all help strengthen the governance of state banks or other state entities engaging in higher-risk activities.

However, there might be cases where, in order to internalize externalities, states may be better off dealing directly with borrowers through a first-tier state bank (that is, becoming agents) than through guarantees provided by a second-tier state bank. In particular, it has been argued that, in downturns, partial guarantees may not be sufficient to overcome bankers' heightened risk aversion. Thus, unless states are willing to assume most or all of the risk, which could subject them to unacceptably high losses, guarantee programs may fail to provide an effective countercyclical tool. Instead, as the argument goes, first-tier state banking provides the only reliable channel to increase lending in a reasonably safe fashion, that is, "when the going gets tough, only state banks get going." As reasonable as this argument may sound, it can also be turned on its head. The more state banks compete head-to-head with private banks, the less private lenders are likely to share information with a state guarantor. Hence, a noncompeting state sector, one that complements but does not substitute, may in fact be best able to maintain an open access to the private information that it needs to monitor the banks and extend the coverage of the guarantees during downturns in a fiscally responsible way.

An important final question is whether state banks should be supervised as private banks. In the case of first-tier state banks, the answer is an unqualified yes. Since state and private banks

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[25] Some lending and guarantee programs by development banks in high-income countries are structured in this way. The Business Development Bank Canada (BDC) small business loan guarantee program is a prime example. See Rudolph (2009).

compete for the same business (they are potential substitutes, at least to a degree), they should be regulated and supervised in exactly the same way as private banks. For second-tier state banks, the answer is not so clear, however. Because such banks are in the business of ensuring against tail risks, the tolerance range involved in calibrating their capital under a value at risk criterion will need, by construction, to be less strict than that applied to private banks. At the same time, the emphasis on uncertain, frontier risk requires a different type of supervision. It should rely on high-end, holistic assessments by panels of experts that balance the economy-wide costs and benefits of the programs that the state bank engages in rather than ready-made, one-size-fits-all rules aimed at ensuring financial stability.

8.   Concluding thoughts

We conclude by highlighting some aspects of this paper's main contributions to the debate on public risk-bearing. We do it by addressing four basic policy questions concerning public sector guarantees that are mainly oriented to fostering financial development and financial inclusion (rather than those mainly oriented to dealing with systematic risk).

Is the traditional emphasis on agency frictions justified? No, agency frictions (adverse selection and lack of collateral) by themselves (i.e., without risk aversion) are highly unlikely to justify developmentally-oriented public guarantees. Yet, combined with risk aversion and collective action failures, agency frictions can help motivate the need for public guarantees that harness the state's superior ability to spread idiosyncratic risk more finely than what is achievable in the market.

Is the traditional emphasis on externalities justified? No, social externalities by themselves do not justify public guarantees and are best dealt with through targeted taxes and subsidies. Yet, a specific form of externalities—participation externalities—is a key ingredient underlying the case for developmentally-oriented public guarantees. Such externalities can justify the state's intervention on the same grounds that justify public goods.

What is new in terms of traditional, apparently low-risk public guarantees? Public guarantees need to focus much more than what they generally do on risk aversion and the resulting differential costs of capital for the public and private sectors. They need to address the basic question of why public guarantee programs that are apparently self-sustainable are not being taken up by the private sector. Where these programs are really self-sustainable, they should be immediately divested to the private sector. When financial systems are not yet mature enough to take over, a clear exit strategy should be formulated. Where there are in fact hidden risks (fat tailed or systemic) that free markets cannot handle well, these risks and potential costs need to be explicitly recognized and accounted for in the public guarantee programs.

What is new in terms of expanding the risk frontier? The emphasis on risk aversion implies that the state's comparative advantage should grow with the level and complexity of risk. Hence, the state would seem to be naturally called to play a more active developmental role by expanding the risk frontier and, hence, helping complete financial markets for, say, long-term finance, infrastructure finance, SME finance, mortgage finance for lower income households, and small farmers. However, much prudence is required, both to overcome public governance

difficulties and to contain the moral hazard that generally accompanies risk-shifting to the state. A cautious approach that carefully aligns public and private incentives and promotes risk discovery through public-private arrangements seems therefore to be called for. Crucial in this regard is the need to price public guarantees adequately. The price of a public guarantee should not only cover the *expected* default losses, as best as they can be measured. It should also cover monitoring costs and, where appropriate, add a premium for the protection it provides against aggregate risk.

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Appendix I: The Mankiw Model

Students borrow at an interest rate r and obtain a return R. Their probability of repayment, p, is uniformly distributed between P_0 and P_1. Only the sufficiently dishonest students will ask for a loan, with the threshold such that:

$$p < \frac{R}{r} \qquad (1)$$

Hence, for an adverse selection equilibrium to prevail (where there are honest students who cannot borrow), the return on the loan must not be too high, such that:

$$R < rP_1 \qquad (2)$$

The bank's cost of funds is the risk-free rate (social cost of funds) ρ. The social benefit of education is assumed to be higher than its social cost:

$$R > \rho \qquad (3)$$

If the mean repayment probability is π, the bank will set the lending rate such that:

$$r = \frac{\rho}{\pi} \qquad (4)$$

Where the average probability of repayment is:

$$\pi = \frac{P_0 + R/r}{2} \qquad (5)$$

Define $\overline{W}$ as the total social value created by the loans in the market equilibrium. It equals the difference between the social benefit per loan, R, and the social cost, ρ, times the number of loans:

$$\overline{W} = (R - \rho)\frac{R/r - P_0}{P_1 - P_0} \qquad (6)$$

The value of the loans in the socially optimal solution where all students borrow would be W^* such that:

$$W^* = R - \rho \qquad (7)$$

By comparing (6) and (7), it immediately follows that $W^* > \overline{W}$ when (2) is satisfied. Instead, a fully subsidized credit guarantee can induce the risk neutral lender to lend to all students at the risk-free interest ρ. Absent a requirement of revenue neutrality, the subsidized guarantee would therefore allow the social optimum to be reached.

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However, from a broader welfare perspective that imposes revenue neutrality and where the distribution of tax payments across the student population matters, such a guarantee is not optimal. With a guarantee, everyone borrows and a share $(P_0 + P_1)/2$ of students (the honest students) repays the loans. Hence, the cost of the guarantee is: $\rho - r\dfrac{P_0 + P_1}{2}$. If the honest students are the only ones who can be taxed to cover this cost, the tax per honest student will be:

$$\tau = \frac{\rho - r(P_0 + P_1)/2}{(P_0 + P_1)/2} \qquad (8)$$

The honest students will only be better off paying the tax if their excess return exceeds the tax:

$$R - r > \tau \qquad (9)$$

Using (8) in (9) and rearranging terms leads to:

$$\frac{R}{\rho} > \frac{2}{P_0 + P_1} \qquad (10)$$

But for an adverse selection equilibrium to exist, (2) needs also to be verified. In turn, since with (4) and (5):

$$\frac{R}{r} = \frac{R/\rho}{2 - R/\rho} P_0 \qquad (11)$$

then, with (11), (2) can be written:

$$\frac{R}{\rho} < 2\frac{P_1}{P_0 + P_1} \qquad (12)$$

Putting together (10) and (12):

$$\frac{2}{P_0 + P_1} < \frac{R}{\rho} < \frac{2P_1}{P_0 + P_1} \qquad (13)$$

This set of inequalities cannot be verified for $P_1 < 1$; hence it is not possible to find an equilibrium where there are honest students who are driven away from the market but would be better off with a guarantee.

Appendix II. Adding risk aversion to the Calomiris-Khan model

Entrepreneurs invest in projects that yield X with probability p, and 0 with probability $1-p$. The project is productive, so that $pX>1$, and its maximum size is one. If the project is terminated early, its liquidation value is $L<1$; if liquidated late it is worth zero. Monitoring is costly and provides an imperfect signal $m \in [0,1]$ on the project's failure probability, such that if the signal indicates failure, failure will actually occur with probability m. Thus, better monitoring provides a better signal.

Entrepreneurs are risk-neutral but are funded by an infinite population of ex ante identical risk-averse investors. Ex post, however, the investor population separates into two groups. Some investors ("wholesalers") choose to invest big in the project and monitor, under the expectation that monitoring will allow them to exit early in the case of a bad project and recoup their investment. Other investors ("retailers") choose to fully diversify. They will limit their investment to an atomistic amount. Assuming projects' probability of success is not systemically correlated across projects nor to investors' income, this allows retailers to be fully diversified, hence to remain de facto risk-neutral. Instead, the lumpiness of wholesalers' investment, which will be needed to make monitoring cost effective, will prevent them from diversifying, making them risk averse.

Guarantors are risk-neutral financial intermediaries who purchase risk from wholesalers and resell it to retailers. The risk transfer takes the form of bonds whose pay off is contingent on the project's failure. In keeping with the binomial structure of the model, we assume that partial guarantees cover uncertain full repayments (with probability $v \in [0,1]$) rather than certain partial repayments. Guarantees are priced fairly. Retailers can monitor the guarantor without incurring any cost (the monitoring pyramid already closes at this level).

The possible states of the world are thus as follows:

- With probability p, the project succeeds, yielding X.
- With probability $(1-p)m$ the project fails; however, given that a correct failure signal has been received, the project is terminated early and yields L; wholesalers get their investment back and retailers get the remainder.
- With probability $(1-p)(1-m)v$ the project goes on and fails; retailers lose their investment but wholesalers recoup it through the guarantee.
- With probability $(1-p)(1-m)(1-v)$ the project goes on, fails and everybody loses his investment (the guarantee is not activated)

If δ is wholesalers' probability of getting their full return, it follows that:

$$1-\delta=(1-p)(1-m)(1-v) \qquad (14)$$

And the variance of the underlying binomial distribution, σ, equals:

$$\sigma=\delta(1-\delta) \qquad (15)$$

Wholesalers and retailers bid competitively on the amounts of wholesale and retail funding, W and D respectively, which are set by the entrepreneur. For notational convenience, we define $s = R^W W$ as wholesalers' total stake in the project, including interest payments. Bidding eliminates excess returns over the safe rate of return, which for simplicity is assumed to be zero.[26]

Wholesalers choose the amount of monitoring m, the rate of return on wholesale funding R^W, and the extent of the guarantee, v, to maximize a mean-variance utility:

$$\underset{m,v,R^W}{Max} E\{U^W\} = [p + (1-p)m + (1-p)(1-m)v]s - W - \frac{a}{2}m^2 - \frac{\varepsilon\sigma}{2}s^2 - Y = 0 \quad (16)$$

In this expression, a measures the cost that wholesalers' incur in monitoring entrepreneurs, ε is the degree of risk aversion, Y the premium on the guarantee, and σ the variance of project outcomes, i.e., a measure of risk. As in any insurance contract, there is moral hazard. Wholesalers have an incentive to shirk, which depends on the extent to which the guarantee internalizes "deviant behavior". Because it is costly for the guarantor to fully discriminate between wholesalers, he sets his fees partly on a collective basis and partly on an individual basis. Thus, while he does charge for all bad behavior collectively, he can do it only to a limited extent on an individual basis. Thus, each individual wholesaler only internalizes a fraction μm ($\mu \in [0,1]$) of cost of the guarantee, taking the rest, $(1-\mu)\hat{m}$, where $\hat{m}$ is collective monitoring, as given. Thus, from the individual wholesaler point of view, the premium he is charged is:

$$Y = (1-p)vs[\mu(1-m) + (1-\mu)(1-\hat{m})] + \frac{b}{2}\mu^2 \quad (17)$$

where b is the cost to the guarantor of monitoring wholesalers (i.e., the recipients of the guarantee).

Replacing (17) in (16):

$$\underset{m,v,R^W}{Max} E\{U^W\} = [p + (1-p)(1-\mu)(\hat{m}-m)v]s - W - \frac{a}{2}m^2 - \frac{b}{2}\mu^2 - \frac{\varepsilon\sigma}{2}s^2 = 0 \quad (18)$$

Thus, the guarantee has two impacts. It reduces the variance of the distribution (σ), hence the risk premium, which is good. But, unless there is full internalization ($\mu=1$), it also affects m, hence undermining monitoring incentives, which is bad.

Since guarantors are risk neutral and the guarantee market is fully competitive, guarantors set μ so as to minimize the premium on the guarantee, which through market arbitrage

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[26] Thus, arbitrage ensures that all retailers' investments remain atomistic. Any retailer wishing to invest more will require to be compensated with a risk premium. However, since the number of retailers is very large, the atomistic retailers will bid the interest rate on retail funds down, pushing the larger retailers out of the market.

will equal its expected cost. Since from their perspective $m = \hat{m}$, this amounts to setting Y such that:

$$Min_{\mu} Y = (1-p)(1-m)vs + \frac{b}{2}\mu^2 \quad (19)$$

Retailers also behave as if they were risk-neutral; hence they maximize:[27]

$$Max_{R^D} E\{U^D\} = (pR^D - 1)D + (1-p)m[L(D+W) - R^W W] = 0 \quad (20)$$

Entrepreneurs, who are also risk neutral, maximize their expected profits:

$$Max_{W,D} E\{\pi^B\} = p[D(X-R^D) + W(X-R^W)] \quad (21)$$

Entrepreneurs internalize the participation constraints of wholesalers and retailers when setting W and D. Hence, pDR^D and $pR^W W$ can be replaced in (21) using their values extracted from (18) and (20), which gives:

$$Max_{W,D} E\{\pi^B\} = [pX - 1 + (1-p)mL](D+W) + (1-p)(\hat{m}-m)(1-\mu)vs - \frac{a}{2}m^2 - \frac{b}{2}\mu^2 - \frac{\varepsilon\sigma}{2}s^2 \quad (22)$$

Maximizing (22) with respect to W and D is equivalent to maximizing with respect to $D + W$ (the total size of the investment) and s (the composition of the funding). In turn, as $pX > 1$, it is obvious that entrepreneurs should choose the maximum size of the investment; hence:

$$D + W = 1 \quad (23)$$

Since risk averse wholesalers and risk neutral retailers just meet their participation constraints (they have zero excess returns), finding the guarantee that maximizes social welfare is equivalent to maximizing entrepreneurial profits while taking into account that guarantees are priced fairly (i.e., removing moral hazard). In turn, since the optimal size of the project and its yield are given, this amounts to minimizing entrepreneurs' funding costs:

$$MaxE\{\pi\} = (1-p)mL - \frac{a}{2}m^2 - \frac{b}{2}\mu^2 - \frac{\varepsilon\sigma}{2}s^2 \quad (24)$$

It follows from this expression that searching for the social optimum is equivalent to maximizing the total size of the surplus pie, as determined by the expected liquidation proceeds adjusted for *total monitoring costs* and the deadweight cost of risk-taking.

The model is solved by deriving the first order conditions with respect to s, m, v and μ. Maximizing (22) with respect to s gives:

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[27] Since the risk coverage instruments are priced fairly, they do not appear in retailers' utility.

$$[(1-p)(L-(1-\mu)vs)-am-\frac{\varepsilon s^2}{2}\frac{\partial\sigma}{\partial m}]\frac{\partial m}{\partial s}=\varepsilon\sigma s \qquad (25)$$

The first order condition of (18) with respect to m yields:

$$am=(1-p)[1-(1-\mu)v]s-\frac{\varepsilon s^2}{2}\frac{\partial\sigma}{\partial m} \qquad (26)$$

Using (26), (25) can be rewritten as:

$$(1-p)(L-s)\frac{\partial m}{\partial s}=\varepsilon\sigma s \qquad (27)$$

From which: $\quad s=\dfrac{L}{1+\varepsilon\sigma s/[(1-p)\partial m/\partial s]} \qquad (28)$

On the other hand, deriving m from the first order condition of (18):

$$m=\frac{(1-p)(1-(1-\mu)v)s+\varepsilon s^2(1-p)(1-v)[1-(1-p)(1-v)]}{a-\varepsilon s^2(1-p)^2(1-v)^2} \qquad (29)$$

The first order condition of (19) can be written:

$$b\mu=(1-p)vs\frac{\partial m}{\partial\mu} \qquad (30)$$

Or, using (29):

$$\mu=\frac{(1-p)^2v^2s^2}{ab-b\varepsilon s^2(1-p)^2(1-v)^2} \qquad (31)$$

Finally, the first order condition of (18) with respect to v is:

$$b\mu\frac{\partial\mu}{\partial v}+\frac{\varepsilon s^2}{2}\frac{\partial\sigma}{\partial v}=0 \qquad (32)$$

Or, using (31), (14) and (15), and after some algebraic manipulations:

$$\mu v=\frac{\varepsilon(2\delta-1)(1-m)}{4(1-p)}\frac{[a-\varepsilon s^2(1-p)^2(1-v)^2]^2}{a+\varepsilon s^2(1-p)^2(1-v)v} \qquad (33)$$

Consider first the case where there is no risk aversion ($\varepsilon=0$). From (31) and (33), it can be readily inferred that $\mu=v=0$: no guarantees are demanded. It therefore follows from (28)

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that $s = L$ (wholesalers take the largest position they can take), and from (29) that $m = \dfrac{(1-p)L}{a}$, which is the socially optimal level of monitoring, as derived from (24). This is the Calomiris-Khan classical result. In the absence of risk aversion, wholesalers' monitoring level is optimal.

Consider now the case with risk aversion. From (31), the condition $\mu \geq 1$ (full internalization) can be written:

$$ab \leq (1-p)^2 s^2 [v^2 + b a (1-v)^2] \qquad (34)$$

But if internalization is complete, wholesalers will always prefer a full guarantee to a partial guarantee since the former eliminates the risk premium term in (18) but results in the same monitoring costs. At the same time, using (28) and (29), a full guarantee implies:

$$s = L$$
$$m = \frac{(1-p)L}{a} \qquad (35)$$

And (34) reduces to:

$$(ab)^{\frac{1}{2}} \leq (1-p)L \qquad (36)$$

It therefore follows from (35) that the full guarantee-full internalization solution replicates the solution without risk aversion (risk is fully spread out and the market equilibrium is socially optimal). At the same time, given that the direct monitoring costs, a, should be sufficiently high to justify imperfect monitoring ($m < 1$), it follows from (35) and (36) that the full internalization-full guarantee equilibrium should also satisfy the following conditions:

$$b < (1-p)L < a \qquad (37)$$

Thus, satisfying (36) and (37) should ensure a socially optimal, full guarantee equilibrium. In this equilibrium, (37) implies that the costs of monitoring the monitor, b, should be lower than the direct monitoring costs, a: There should be "efficiency gains" in monitoring through the monitoring pyramid. At the same time, (36) implies that the average (compounded) monitoring costs, $(ab)^{\frac{1}{2}}$, should be lower than the maximum possible monitoring benefit *(1-p)L.*