BANK FOR INTERNATIONAL SETTLEMENTS

BIS Working Papers

No 468

The redistributive effects of financial deregulation: wall street versus main street

by Anton Korinek and Jonathan Kreamer

Monetary and Economic Department

October 2014

JEL classification: G28, E25, E44, H23

Keywords: Financial regulation, distributive conflict, rent extraction, growth of the financial sector

This publication is available on the BIS website (www.bis.org).

ISSN 1020-0959 (print)
ISSN 1682-7678 (online)

The Redistributive Effects of Financial Deregulation:
Wall Street Versus Main Street*

Anton Korinek
Johns Hopkins University and NBER

Jonathan Kreamer
University of Maryland

September 2014

Abstract

Financial regulation is often framed as a question of economic efficiency. This paper, by contrast, puts the distributive implications of financial regulation at center stage. We develop a formal model in which the financial sector benefits from financial risk-taking by earning greater expected returns. However, risk-taking also increases the incidence of large losses that lead to credit crunches and impose negative externalities on the real economy. We describe a Pareto frontier along which different levels of risk-taking map into different levels of welfare for the two parties, pitting Main Street against Wall Street. A regulator has to trade off efficiency in the financial sector, which is aided by deregulation, against efficiency in the real economy, which is aided by tighter regulation and a more stable supply of credit. We also show that financial innovation, asymmetric compensation schemes, concentration in the banking system, and bailout expectations enable or encourage greater risk-taking and allocate greater surplus to Wall Street at the expense of Main Street.

JEL Codes: G28, E25, E44, H23
Keywords: financial regulation, distributive conflict, rent extraction, growth of the financial sector

*We would like to acknowledge helpful comments and discussions with George Akerlof, Robert Bichsel, Olivier Blanchard, Claudio Borio, Maya Eden, Bruce Greenwald, Gita Gopinath, Andy Haldane, Oliver Hart, Jean Helwege, Olivier Jeanne, Bob King, Andrew Levin, Chang Ma, Jonathan Ostry, Marco Pagano, Goetz von Peter, Ricardo Reis, Jean-Charles Rochet, Damiano Sandri, Joseph Stiglitz, Elif Ture and Razvan Vlahu, as well as participants in several conferences and seminars. Korinek thanks the BIS Research Fellowship and INET/CIGI for financial support. A significant part of the paper was written during Korinek's visit at the BIS. The views expressed are our own and not necessarily those of the BIS. For contact information please visit `http://www.korinek.com`

1 Introduction

Financial regulation is often framed as a question of economic efficiency. However, the intense political debate on the topic suggests that redistributive questions are front and center in setting financial regulation. In the aftermath of the financial crisis of 2008/09, for example, consumer organizations, labor unions and political parties championing worker interests have strongly advocated a tightening of financial regulation, whereas financial institutions and their representatives have argued the opposite case and have issued dire warnings of the dangers and costs of tighter regulation.

This paper makes the case that there is a distributive conflict over the level of risk-taking in the financial sector, and by extension over the tightness of financial regulation, pitting Wall Street against Main Street. Financial institutions prefer more risk-taking than what is optimal for the rest of society because risk-taking delivers higher expected returns. However, it also comes with a greater incidence of large losses that lead to credit crunches and negative externalities on the real economy. This link between financial regulation and volatility in the real economy has been documented e.g. by Reinhart and Rogoff (2009).

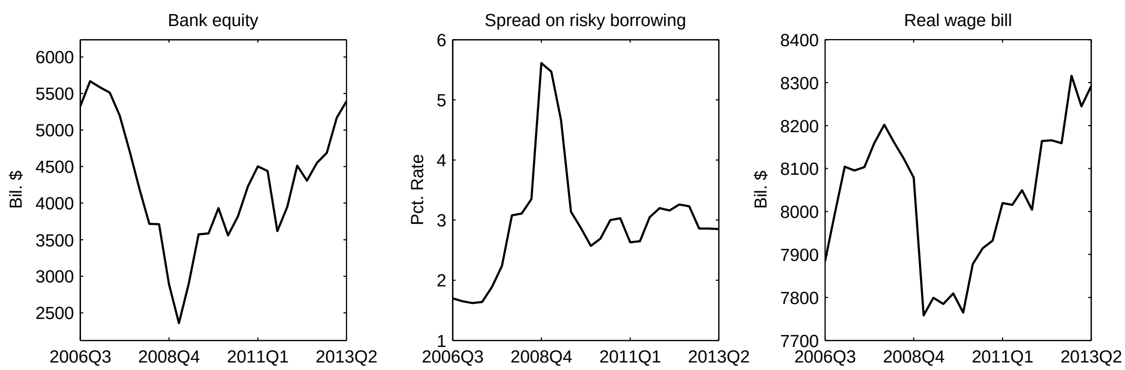

Figure 1: Bank equity, interest rate spread and wage bill.

Figure 1 illustrates the negative externalities from losses in the financial sector during the 2008/09 financial crisis in the US. The first panel depicts the decline in aggregate bank equity during the crisis.[1] The second panel shows the concurrent increase in the spread between interest rates for risky borrowing and safe rates. Although some of this increase is attributable to higher default risk, a significant fraction is due to constraints in the financial system (see e.g. Adrian et al., 2010). The last panel shows the steep decline in the wage bill over the course of the crisis. The recovery in this variable was somewhat sluggish, possibly because the initial shock to the financial sector was aggravated by aggregate demand problems and constraints on household balance sheets.

[1]For a detailed description of data sources, see appendix C.

This paper develops a formal model to analyze the distributive conflict inherent in regulating risk-taking in the financial sector. The financial sector plays a special role in the economy as the only sector that can engage in financial intermediation and channel capital into productive investments. This assumption applies to the financial sector in a broad sense, including broker-dealers, the shadow financial system and all other actors that engage in financial intermediation. For simplicity, we will refer to all actors in the financial sector broadly defined as "bankers" or "Wall Street."

There are two types of financial imperfections. First, bankers suffer from a commitment problem and need to have sufficient capital in order to engage in financial intermediation. This captures the standard notion that bankers need to have "skin in the game" to ensure proper incentives. Secondly, insurance markets between bankers and the rest of society are incomplete, and bank equity is concentrated in the hands of bankers.

Because of the "skin in the game"-constraint, a well-capitalized financial sector is essential for the rest of the economy, which we can think of as "Main Street." In particular, Wall Street needs to hold a certain minimum level of capital to intermediate the first-best level of credit and achieve the optimal level of output on Main Street. If aggregate bank capital declines below this threshold, binding financial constraints force bankers to cut back on credit to Main Street. The resulting credit crunch causes output to contract, wages to decline and lending spreads to increase. At a technical level, these price movements constitute pecuniary externalities that hurt Main Street but benefit Wall Street.

When financial institutions decide how much risk to take on, they trade off the benefits of risk-taking in terms of higher expected return with the risk of becoming constrained. They always find it optimal to choose a positive level of risk-taking. By contrast, workers are averse to fluctuations in bank capital. They prefer less financial risk-taking and a stable supply of credit to the real economy. This generates a Pareto frontier along which higher levels of risk-taking correspond to higher levels of welfare for bankers and lower levels of welfare for workers. Financial regulation imposes constraints on risk-taking, which move the economy along this Pareto frontier. Financial regulators have to trade off greater efficiency in the financial sector, which relies on risk-taking, against greater efficiency in the real economy, which requires a stable supply of credit.[2]

The distributive conflict over risk-taking and regulation is the result of both financial imperfections in our model. If bankers weren't financially constrained, then

[2] Our findings are consistent with the experience of a large number of countries in recent decades: deregulation allowed for record profits in the financial sector, which benefited largely the financial elite (see e.g. Philippon and Reshef, 2013). Simultaneously, most countries also experienced a decline in their labor share (Karabarbounis and Neiman, 2014). When crisis struck, e.g. during the financial crisis of 2008/09, economies experienced a sharp decline in financial intermediation and real capital investment, with substantial negative externalities on workers and the rest of the economy. Such occasionally binding financial constraints are generally viewed as the main driving force behind financial crises in the quantitative macro literature (see e.g. Korinek and Mendoza, 2014).

Fisherian separation would hold: they could always intermediate the optimal amount of capital, and their risk-taking would not affect the real economy. Similarly, if risk markets were complete, then bankers and the rest of the economy would share not only the downside but also the benefits of financial risk-taking. In both cases, the distributive conflict would disappear.

Drawing an analogy to more traditional forms of externalities, financial deregulation is similar to relaxing safety rules on nuclear power plants: such a relaxation will reduce costs, which increases the profits of the nuclear industry and may even benefit the rest of society via reduced electricity rates in good states of nature. However, it comes at a heightened risk of nuclear meltdowns that impose massive negative externalities on the rest of society. In expectation, relaxing safety rules below their optimum level increases the profits of the nuclear sector at the expense of the rest of society.

We analyze a number of extensions to study how risk-taking in the financial sector interacts with the distribution of resources in our model economy. When bank managers receive asymmetric compensation packages, they will take on risk and expose the economy to larger negative externalities. If bankers have market power, their precautionary incentives are reduced and they take on more risk which hurts workers, highlighting a new dimension of welfare losses from concentrated banking systems. Financial innovation that expands the set of available assets allows the financial sector to take on more risk, and in some cases can make workers unambiguously worse off. Finally, greater risk-taking induced by bailouts likely leads to a significantly larger redistribution of surplus than the explicit transfers that financial institutions receive during bailouts. These extensions suggest that the externalities from credit crunches may easily represent the most significant social cost of distortions in the financial sector.

Our analytic findings suggest a number of policy interventions in the real world that regulators could implement if their main concern is a stable supply of credit to the real economy: they could (i) separate risky activities, such as proprietary trading, from traditional financial intermediation, (ii) impose higher capital requirements on risky activities, in particular on those that do not directly contribute to lending to the real economy, (iii) limit payouts if they endanger a sufficient level of capitalization in the financial sector, (iv) use structural policies that reduce incentives for risk-taking, and (v) force recapitalizations when necessary, even if they impose private costs on bankers.

A Pareto-improvement could only be achieved if deregulation was coupled with measures that increase risk-sharing *between* Wall Street and Main Street so that the upside of risk-taking also benefits Main Street. Even if formal risk markets for this are absent, redistributive policies such as higher taxes on financial sector profits that are used to strengthen the social safety net for the rest of the economy would constitute such a mechanism.

Literature This paper is related to a growing literature on the effects of financial imperfections in macroeconomics (see e.g. Gertler and Kiyotaki, 2010, for an overview). Most of this literature describes how binding financial constraints may amplify and propagate shocks (see e.g. Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997) and lead to significant macroeconomic fluctuations that affect output, employment and interest rates (see e.g. Gertler and Karadi, 2011). The main contribution of our paper is to focus on the redistributive effects of such fluctuations.

Our paper is also related to a growing literature on financial regulation (see e.g. Freixas and Rochet, 2008, for a comprehensive review), but puts the distributive implications of such financial policies center stage. One recent strand of this literature argues that financial regulation should be designed to internalize pecuniary externalities in the presence of incomplete markets.[3] Our paper is based on pecuniary externalities from bank capital to wage earners and studies the redistributive implications.

In the discussion of optimal capital standards for financial institutions, Admati et al. (2010) and Miles et al. (2012) have argued that society at large would benefit from imposing higher capital standards. They focus on the direct social cost of risk-shifting by banks on governments, whereas this paper highlights an additional indirect social cost from the increased incidence of costly credit crunches. Estimates for the financial crisis of 2008/09 suggest that in most countries, including the US, the indirect social cost of the credit crunch far outweighed the direct monetary costs of crisis-related bailouts (see e.g. Haldane, 2010).

In the empirical literature, Kaplan and Rauh (2010) and Philippon and Reshef (2012) provide evidence that the surplus created during booms accrued in large part to insiders in the financial sector, i.e. bankers in our framework. Furceri et al. (2014) provide cross-country evidence on the deleterious effects of capital account liberalization on inequality. Larrain (2014) complements this with evidence on adverse effects of liberalization on wage inequality.

The rest of the paper proceeds as follows: The ensuing section develops an analytical model in which bankers intermediate capital to the real economy. Section 3 analyzes the determination of equilibrium and how changes in bank capital differentially affect the banking sector and the real economy. Section 4 describes the redistributive conflict over risk-taking between bankers and the real economy. Section 5 analyzes the impact of factors such as market power, agency problems, financial innovation, and bailouts on this conflict. All proofs are collected in Appendix A.

[3] See e.g. Lorenzoni (2008), Jeanne and Korinek (2010ab, 2012), Bianchi and Mendoza (2010), Korinek (2011), Benigno et al. (2012) and Gersbach and Rochet (2012) for papers on financial regulation motivated from asset price externalities, or Caballero and Lorenzoni (2014) for a paper on currency intervention based on wage externalities in an emerging economy. Campbell and Hercowitz (2009) study pecuniary externalities on the interest rate that arise in the transition from an equilibrium with low household debt to an equilibrium with high household debt. Kreamer (2014) studies the effect of household debt on the speed of recovery following a period of high unemployment.

2 Model Setup

Consider an economy with three time periods, $t = 0, 1, 2$, and a unit mass each of two types of agents: bankers and workers. Furthermore, there is a single good that serves both as consumption good and capital.

Bankers (Wall Street) In period 0, bankers are born with one unit $e_0 = 1$ of the consumption good. They invest a fraction $x \in [0, 1]$ of it in a project that delivers a risky payoff $\tilde{A}$ in period 1 with a continuously differentiable distribution function $G(\tilde{A})$ over the domain $[0, \infty)$, a density function $g(\tilde{A})$ and an expected value $E[\tilde{A}] > 1$. They hold the remainder $(1 - x)$ in a storage technology with gross return 1.

After the realization of the risky payoff $\tilde{A}$ in period 1, the resulting equity level of bankers is

$$e = x\tilde{A} + (1 - x) \tag{1}$$

Consistent with the banking literature, we use the term "bank capital" to refer to bank equity e in the following. However, this is a pure naming convention; bank capital is distinct from physical capital.

In period 1, bankers raise d deposits at a gross deposit rate of r and lend $k \leq d+e$ to the productive sector of the economy at a gross interest rate R. In period 2, bankers are repaid and value total profits for Wall Street in period 2 according to a linear utility function $\pi = Rk - rd$.

Workers (Main Street) Workers are born in period 1 with a large endowment m of consumption goods. They lend an amount d of deposits to bankers at a deposit rate of r and hold the remainder in a storage technology with gross return 1. No arbitrage implies that the deposit rate satisfies $r = 1$.

In period 2, workers inelastically supply one unit of labor $\ell = 1$ at the prevailing market wage w. Worker utility depends only on their total consumption, which for notational simplicity is normalized by subtracting the constant m so that $u = w\ell$.

In the described framework, risk markets between Wall Street and Main Street are incomplete since workers are born in period 1 after the technology shock $\tilde{A}$ is realized and cannot enter into risk-sharing contracts with bankers in period 0. All the risk $x\tilde{A}$ from investing in the risky technology therefore needs to be borne by Wall Street. An alternative microfoundation for this market incompleteness would be that obtaining the distribution function $G(\tilde{A})$ requires that bankers exert an unobservable private effort, and insuring against fluctuations in $\tilde{A}$ would destroy their incentives to exert this effort. In practice, bank capital is subject to significant fluctuations, and a large fraction of this risk is not shared with the rest of society.[4] Section 4.1 investigates the implications of reducing this market incompleteness.

[4]For example, Wall Street banks routinely pay out up to half of their revenue as employee compensation in the form of largely performance-dependent bonuses, constituting an implicit equity stake by insiders in their firms. A considerable fraction of remaining explicit bank equity is also held

Firms Firms are collectively owned by Main Street and are neoclassical and competitive. Firms borrow k units of good from Wall Street at interest rate R at the end of period 1, which they invest as physical capital. They hire labor ℓ at wage w in period 2. They combine the two factors to produce output in period 2 according to the production function $F(k,\ell) = Ak^{\alpha}\ell^{1-\alpha}$ with $\alpha \in (0,1)$. There is no uncertainty in firms' production. Firms maximize profits $F(k,\ell) - w\ell - Rk$ and find it optimal to equate the marginal product of each factor to its price, $F_k = R$ and $F_\ell = w$. In equilibrium they earn zero profits. A timeline that summarizes our setup is presented in Figure 2.

Remark 1: In the described setup, the risk-taking decision x of bankers is separate from the financial intermediation function k, since they occur in separate time periods. This simplifies the analysis and sharpens our focus on the asymmetric costs of credit crunches, but implies that there is no direct contemporaneous benefit to workers if bankers invest more in the risky payoff with higher expected return. Appendix B.2 shows that our results continue to hold if the risk-taking and financial intermediation functions of bankers are intertwined. It considers an aggregate production function in periods 1 and 2 of $[\tilde{A}_t x_t + 1 - x_t]F(k_t, \ell_t)$, so that workers benefit immediately from risk-taking x_t through higher wages in period t.[5]

Remark 2: The model setup assumes for simplicity that the endowments of labor and savings as well as the firms are owned by Main Street. The results would be unchanged if these ownership claims were assigned to separate types of agents, since savers earn zero net returns and firms earn zero profits in equilibrium. For example, there could be an additional type of agent called capital owners who own all the savings and firms of the economy. Furthermore, our main insights are unchanged if labor supply is elastic.

2.1 First-Best Allocation

A planner who implements the first-best maximizes aggregate surplus in the economy

$$\max_{x,e,k,\ell} E\left[F(k,\ell) + e + m - k\right] \quad \text{s.t.} \quad e = x\tilde{A} + (1-x) \tag{2}$$

where $x \in [0,1]$ and $\ell \in [0,1]$. In period 2, the optimal labor input is $\ell^* = 1$, and the optimal level of capital investment satisfies $k^* = (\alpha A)^{\frac{1}{1-\alpha}}$, i.e. it equates the marginal return to investment to the return on the storage technology, $R^* = F_k(k^*, 1) = 1$. As discussed earlier, m is large enough that the resource constraint $k \leq e + m$ can be

by insiders. Furthermore, only 17.9% of US households hold direct stock investments, and another 33.2% hold equity investments indirectly, e.g. via retirement funds or other mutual funds. And this equity ownership is heavily skewed towards the high end of the income distribution (see e.g. Table A2a in Kennickel, 2013).

[5] In a similar vein, it can be argued that risky borrowers (e.g. in the subprime segment) benefited from greater bank risk-taking because they obtained more and cheaper loans.

Period 0	Period 1	Period 2
• Banks enter with initial endowment 1 • Banks choose risky investment $x \in [0, 1]$	• Shock $\tilde{A}$ realized • Bank equity $e = (1 - x) + \tilde{A}x$ • Households enter and deposit d at rate r in banks • Bankers supply capital $k \leq d + e$ to firms	• Households supply labor $\ell = 1$ • Firms produce $F(k, \ell)$ • Banks receive return Rk, households obtain $w\ell$ • Banks pay households rd

Figure 2: Timeline

omitted, i.e. there are always sufficient funds available in the economy to invest k^* in the absence of market frictions. The marginal product of labor at the first-best level of capital is $w^* = F_\ell(k^*, 1)$.

In period 0, the first-best planner chooses the portfolio allocation that maximizes expected bank capital $E[e]$. Since $E[\tilde{A}] > 1$, she will pick the corner solution $x = 1$. Since a fraction $\alpha F(k^*, 1)$ of production is spent on investment, the net social surplus generated in the first-best is $S^* = (1 - \alpha) F(k^*, 1) + E[\tilde{A}]$.

2.2 Financial Constraint

We assume that bankers are subject to a commitment problem to capture the notion that bank capital matters. Specifically, bankers have access to a technology that allows them to divert a fraction $(1 - \phi)$ of their gross revenue, where $\phi \in [0, 1]$. By implication depositors can receive repayments on their deposits that constitute at most a fraction ϕ of the gross revenue of bankers. Anticipating this commitment problem, depositors restrict their supply of deposits to satisfy the constraint

$$rd \leq \phi Rk \tag{3}$$

An alternative interpretation of this financial constraint follows the spirit of Holmstrom and Tirole (1998): Suppose that bankers in period 1 can shirk in their monitoring effort, which yields a private benefit of B per unit of period 2 revenue but creates the risk of a bank failure that may occur with probability Δ and that results in a complete loss. Bankers will refrain from shirking as long as the benefits are less than the costs, or $BRk \leq \Delta[Rk - rd]$. If depositors impose the constraint above for $\phi = 1 - \frac{B}{\Delta}$, they can ensure that bankers avoid shirking and the associated risk of bankruptcy.[6]

Remark: Our model assumes that all credit is used for capital investment so that binding constraints directly reduce supply in the economy. An alternative and complementary assumption would be that credit is required to finance (durable) consumption so that binding constraints reduce demand. In both setups, binding financial constraints hurt the real economy, with similar redistributive implications.[7]

3 Laissez-Faire Equilibrium

The laissez-faire equilibrium of the economy is defined as the set of prices $\{r, R, w\}$ and allocation $\{x, e, d, k\}$, with all variables except x contingent on $\tilde{A}$, such that the decisions of bankers, workers, and firms are optimal given their constraints, and the markets for capital, labor and deposits clear.

We solve for the laissez-faire equilibrium in the economy with the financial constraint using backward induction, i.e. we first solve for the optimal period 1 equilibrium of bankers, firms and workers as a function of a given level of bank capital e. Then we analyze the optimal portfolio choice of bankers in period 0, which determines e.

3.1 Period 1 Equilibrium

Employment is always at its optimum level $\ell = 1$, since wages are flexible. The financial constraint is loose if bank capital is sufficiently high that bankers can intermediate the first-best amount of capital, $e \geq e^* = (1-\phi)k^*$. In this case, the deposit and lending rates satisfy $r = R = 1$ and bankers earn zero returns on lending. The wage level is $w^* = (1-\alpha) F(k^*, 1)$. This situation corresponds to "normal times."

If bank capital is below the threshold $e < e^*$ then the financial constraint binds and the financial sector cannot intermediate the first-best level of physical capital. This corresponds to a "credit crunch " or "financial crisis" since the binding financial constraints reduce output below its first-best level. Workers provide deposits up to the constraint $d = \phi Rk/r$, the deposit rate is $r = 1$, and the lending rate is $R = F_k(k, 1)$. Equilibrium capital investment in the constrained region, denoted by

[6] If the equilibrium interest rate is sufficiently large that $R > \frac{1}{1-\Delta+B}$, banks would prefer to offer depositors a rate $r = \frac{1}{1-\Delta}$ and shirk in their monitoring, incurring the default risk Δ. However, this outcome is unlikely to occur in practice because such high interest rates would likely prompt a bailout, as discussed in Section 5.4

[7] Note that the benchmark model does not account for the procyclicality of financial leverage, which is documented e.g. in Brunnermeier and Pedersen (2009). However, this could easily be corrected by making the parameter ϕ vary with the state of nature so that $\phi(\tilde{A})$ is an increasing function.

$\hat{k}(e)$, is implicitly defined by the equation

$$k = e + \phi k F_k(k, 1) \tag{4}$$

which has a unique positive solution for any $e \geq 0$. Overall, capital investment is given by the expression

$$k(e) = \min\left\{\hat{k}(e), k^*\right\} \tag{5}$$

Equilibrium $k(e)$ is strictly positive, strictly increasing in e over the domain $e \in [0, e^*)$ and constant at k^* for $e \geq e^*$. The equilibrium lending rate is then $R(e) = \alpha F(k(e), 1) / k(e)$. Equilibrium profits of the banking sector and worker utility are

$$\pi(e) = e + \alpha F(k(e), 1) - k(e) \tag{6}$$

$$w(e) = (1-\alpha) F(k(e), 1) \tag{7}$$

and total utilitarian surplus in the economy is $s(e) = w(e) + \pi(e)$.

Focusing on the decisions of an individual banker i, it is useful to distinguish individual bank capital e^i, which is a choice variable, from aggregate bank capital e, which is exogenous from an individual perspective. Then the level of physical capital intermediated by banker i and the resulting profits are respectively [8]

$$k\left(e^i, e\right) = \min\left\{k^*, \frac{e^i}{1 - \phi R(e)}\right\} \tag{8}$$

$$\pi\left(e^i, e\right) = e^i + [R(e) - 1] \cdot k\left(e^i, e\right) \tag{9}$$

In equilibrium, $e^i = e$ will hold.

Panel 1 of Figure 3 depicts the payoffs of bankers and workers as a function of aggregate bank capital e. As long as $e < e^*$, physical capital investment falls short of the first best level. In this region, the welfare of workers and of bankers are strictly increasing concave functions of bank capital. Once bank capital reaches the threshold e^*, the economy achieves the first-best level of investment. Any bank capital beyond this point just reduces the amount of deposits that bankers need to raise, which increases their final payoff in period 2 but does not benefit workers. Beyond the threshold e^*, worker utility therefore remains constant and bank profits increase linearly in e. This generates a non-convexity in the function $\pi(e)$ at the threshold e^*. Our analytical findings on the value of bank capital are consistent with the empirical regularities of financial crises documented in e.g. Reinhart and Rogoff, 2009.

[8] Technically, when financial intermediation is unconstrained at the aggregate level ($e > e^*$), there is a continuum of equilibrium allocations of k^i since the lending spread is zero and individual bankers are indifferent between intermediating or not. The equation gives the symmetric level of capital intermediation k^* for this case.

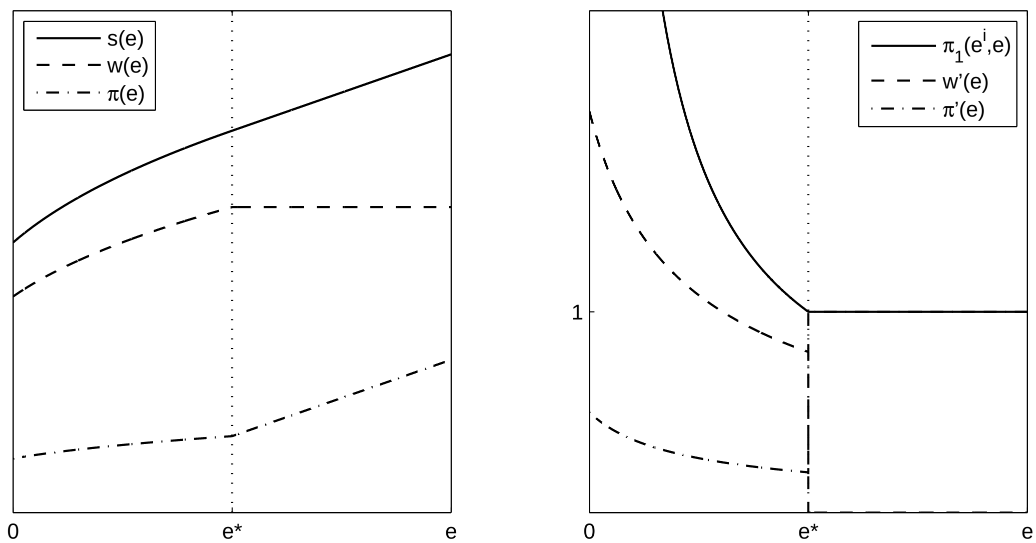

Figure 3: Welfare and marginal value of bank capital e.[9]

3.2 Marginal Value of Bank Capital

How do changes in bank capital affect output and the distribution of surplus in the economy? If bankers are financially constrained in aggregate, i.e. if $e < e^*$, then a marginal increase in bank capital e allows bankers to raise more deposits and leads to a greater than one-for-one increase in capital investment k. Applying the implicit function theorem to (4) in the constrained region yields

$$k'(e) = \frac{1}{1 - \phi\alpha F_k} > 1 \quad \text{for} \quad e < e^* \tag{10}$$

If bankers are unconstrained, $e \geq e^*$, then additional bank capital e leaves physical capital investment unaffected at the first-best level k^*; therefore $k'(e) = 0$.

The effects of changes in bank capital for the two sectors differ dramatically depending on whether the financial constraint is loose or binding. In the unconstrained region $e \geq e^*$, the consumption value for bankers $\pi'(e) = 1$ is the only benefit of additional bank capital since $k'(e) = w'(e) = 0$. Bank capital is irrelevant for workers and the benefits of additional capital accrue entirely to bankers.

By contrast, in the constrained region $e < e^*$, additional bank capital increases physical capital intermediation k and output $F(k, 1)$. A fraction $(1 - \alpha)$ of the additional output F_k accrues to workers via increased wages, and a fraction α of the output net of the additional physical capital input accrues to bankers.[10] These effects

[10] Technically, these effects of bank capital on wages $w(e)$ and the return on capital $R(e)$ constitute *pecuniary externalities*. When atomistic bankers choose their optimal equity allocations, they take all prices as given and do not internalize that their collective actions will have general equilibrium effects that move wages and the lending rate.

are illustrated in Panel 2 of Figure 3.

When $e < e^*$, wages decline because labor is a production factor that is complementary to capital in the economy's production technology. Lending rates rise because the financial constraint creates scarcity, which drives up the return to capital investment. The difference between the lending rate and the deposit rate $r = 1$ allows bankers to earn a spread $R(e) - 1 > 0$. Observe that this spread plays a useful social role in allocating risk because it signals scarcity to bankers: there are extra returns available for carrying capital into constrained states of nature. However, the scarcity rents also redistribute from workers to bankers.

Equity Shortages and Redistribution It is instructive to observe that small shortages of financial sector capital have first order redistributive effects but only second order efficiency effects. In particular, consider an economy in which bank capital is e^* so that the unconstrained equilibrium can just be implemented. Consider a wealth-neutral reallocation of the wealth of bankers across periods 1 and 2: bankers lose an infinitesimal amount ε of bank capital in period 1 so as to tighten their financial constraint, and regain it in period 2. The resulting payoffs for bankers and workers are $\pi(e^* - \varepsilon) + \varepsilon$ and $w(e^* - \varepsilon)$.

Lemma 1 (Redistributive Effects of Equity Shortages) *A marginal tightening of the financial constraint around the threshold e^* has first-order redistributive effects but only second-order efficiency costs.*

Proof. See Appendix A for a proof of all lemmas and propositions. ■

Intuitively, a marginal tightening of the constraint imposes losses on workers from lower wages that precisely equal the gains to bankers from higher lending spreads, i.e. the redistribution between workers and bankers occurs at a rate of one-to-one. Conceptually, this is because pecuniary externalities are by their very nature redistributions driven by changes in prices. In our model, when financial constraints reduce the amount of capital intermediated and push down wages, the losses of workers equal the gains to firms. Similarly, when the lending rate rises, the losses to firms equal the gains to bankers. Since firms make zero profits, the losses to workers have to equal the gains to bankers. Put differently, since bankers are the bottleneck in the economy when the financial constraint binds, they extract surplus from workers in the form of scarcity rents.

3.3 Determination of Period 0 Risk Allocation

An individual banker i takes the lending rate R as given and perceives the constraint on deposits $d \leq \phi Rk$ as a simple leverage limit. When a banker is constrained, she perceives the effect of a marginal increase in bank capital e^i as increasing her intermediation activity by $k_1\left(e^i, e\right) = \frac{1}{1-\phi R}$, which implies an increase in bank profits by

$$\pi_1\left(e^i, e\right) = 1 + \left[R\left(e\right) - 1\right] k_1\left(e^i, e\right) \tag{11}$$

In period 0, bankers decide what fraction x of their endowment to allocate to the risky project. In the laissez-faire equilibrium, banker i takes the aggregate levels of x and e as given and chooses $x^i \in [0,1]$ to maximize $\Pi^i\left(x^i; x\right) = E\left[\pi\left(e^i, e\right)\right]$. At an interior optimum, the optimality condition of bankers is

$$E\left[\pi_1\left(e^i, e\right)\left(\tilde{A} - 1\right)\right] = 0, \tag{12}$$

i.e. the risk-adjusted return on the stochastic payoff $\tilde{A}$ equals the return of the safe storage technology.

The choice of x is determined by two opposing forces. Since $E[\tilde{A}] > 1$, the risky asset yields a higher expected return than the safe asset. Opposing this is a precautionary motive: following low realizations of $\tilde{A}$, aggregate bank capital is in short supply and bankers earn scarcity rents. As a result, bankers optimally trade off the opportunity to earn excess profits from the risky asset in period 0 versus excess profits from lending in period 1 when bank capital is scarce.

The stochastic discount factor π_1 in this expression is given by equation (11) and is strictly declining in e as long as $e < e^*$ and constant at 1 otherwise. Observe that each banker i perceives his stochastic discount factor as independent of his choices of e^i and x^i. However, in a symmetric equilibrium, $e^i = e$ as well as $x^i = x$ have to hold, and equilibrium is given by the level of x and the resulting realizations $e = \tilde{A}x + (1 - x)$ such that the optimality condition (12) is satisfied. As long as $E[\tilde{A}] > 1$, the optimal allocation to the risky project satisfies $x > 0$. If the expected return is sufficiently high, equilibrium is given by the corner solution $x = 1$. Otherwise it is uniquely pinned down by the optimality condition (12).

Denote by x^{LF} the fraction of their initial assets that bankers allocate to the risky project in the laissez-faire equilibrium. The resulting levels of welfare for workers and entrepreneurs are $\Pi^{LF} = E\left[\pi\left(1 - x^{LF} + \tilde{A}x^{LF}\right)\right]$ and $W^{LF} = E\left[w\left(1 - x^{LF} + \tilde{A}x^{LF}\right)\right]$.

For a given risky portfolio allocation x, let $A^*\left(x\right)$ be the threshold of $\tilde{A}$ above which bank capital e is sufficiently high to support the first-best level of production. $A^*(x)$ satisfies

$$A^*\left(x\right) = 1 + \frac{e^* - 1}{x} \tag{13}$$

Well-Capitalized Banking System If $e^* \leq 1$ (which can equivalently be read as $e_0 \geq e^*$ since $e_0 = 1$), then the safe return is sufficient to avoid the financial constraint and the first-best level of capital intermediation k^* would be reached for sure with a perfectly safe portfolio $x = 0$. This case corresponds to an economy in which the financial sector is sufficiently capitalized to intermediate the first-best amount of capital without any extra risk-taking. In this case, the risky project $\tilde{A}$ is a diversion from the main intermediation business of banks.[11]

For this case, bankers find it optimal to choose $x^{LF} > 1 - e^*$ (or, equivalently, $x^{LF} > e_0 - e^*$), i.e. they take on sufficient risk so that the financial constraint is binding for sufficiently low realizations of the risky return so that $A^*(x) > 0$. This is because the expected return on the risky project dominates the safe return, and bankers perceive the cost of being marginally constrained as second-order. Also observe that for $e^* < 1$, the function $A^*(x)$ is strictly increasing from $A^*(1 - e^*) = 0$ to $A^*(1) = e^*$, i.e. more risk-taking makes it more likely that the financial sector becomes constrained.

Under-Capitalized Banking System If $e^* > 1$ (or, equivalently, $e_0 < e^*$), the economy would be constrained if bankers invested all their endowment in the safe return. This corresponds to an economy in which banks are systematically undercapitalized and risk-taking helps mitigate these constraints. In that case, the function $A^*(x)$ is strictly decreasing from $\lim_{x \to 0} A^*(x) = \infty$ to $A^*(1) = e^*$, i.e. more risk-taking makes it more likely that the financial sector becomes *un*constrained.

4 Pareto Frontier

We describe the redistributive effects of financial deregulation by characterizing the Pareto frontier of the economy, which maps different levels of financial risk-taking to different levels of welfare for the financial sector and the real economy. Financial regulation/deregulation moves the economy along this Pareto frontier.

Denote the period 0 allocation to the risky project that is collectively preferred by bankers by

$$x^B = \arg\max_{x \in [0,1]} E\left[\pi(\tilde{A}x + 1 - x)\right] \tag{14}$$

Similarly, let x^W be the level of risk-taking collectively preferred by workers, which maximizes $E[w(e)]$.

In a well-capitalized banking system, i.e. for $e^* \leq 1$ (equivalently, $e_0 \geq e^*$), workers prefer that risk-taking in the financial sector is limited to the point where financial constraints will be loose in all states of nature so that the first-best level of capital investment k^* can be implemented. This is guaranteed for any $x \in [0, 1 - e^*]$. Since workers are indifferent between all x within this interval but bankers benefit from risk-taking, the only point from this interval that is on the Pareto-frontier is $x^W = 1 - e^*$. In an under-capitalized banking system, i.e. for $e^* > 1$ (equivalently, $e_0 < e^*$), the optimal risk allocation for workers involves a positive level of risk-taking $x^W > 0$ – workers benefit from a little bit of risk because the safe return produces insufficient

[11] Examples include a diversification from retail banking into investment banking, or loans by US banks to Latin American governments that offer extra returns at extra risk.

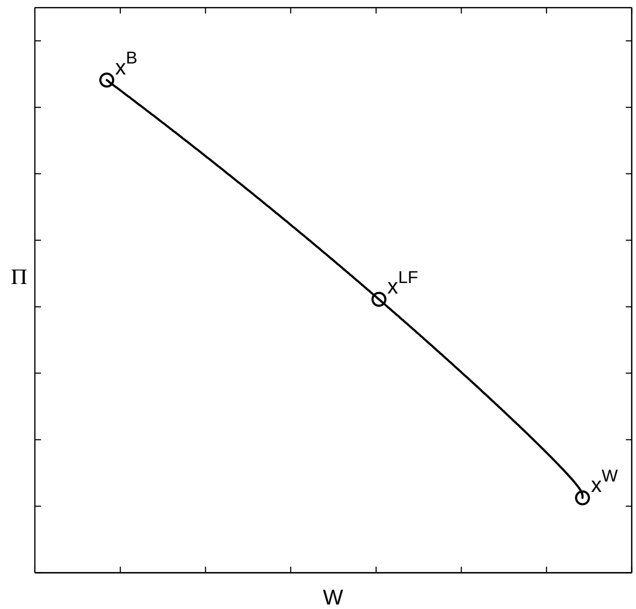

Figure 4: Pareto frontier

bank capital to intermediate the first-best amount of capital k^*, and risk-taking in period 0 increases the expected availability of finance in period 1.

Definition 2 (Pareto Frontier) *The Pareto frontier of the economy consists of all pairs of bank profits and worker wages* $(\Pi(x), W(x))$ *for* $x \in [x^W, x^B]$*.*

To ensure that the Pareto frontier is non-degenerate, we assume that the optimal levels of risk-taking for workers and in the decentralized equilibrium are interior and satisfy $x^W < 1$ and $x^{LF} < 1$. This is a weak assumption that holds whenever the risk-reward trade-off associated with $\tilde{A}$ is sufficiently steep.

Proposition 3 (Characterization of Pareto Frontier) *(i) The risk allocations that are collectively preferred by workers and bankers, respectively, satisfy* $x^W < x^B$*.*

(ii) Over the interval $[x^W, x^B]$*, the expected utility of workers* $W(x)$ *is strictly decreasing in* x*, and the expected utility of bankers* $\Pi(x)$ *is strictly increasing in* x*.*

(iii) The laissez-faire equilibrium satisfies $x^{LF} < x^B$*. If* $e^* \leq 1$ *then* $x^W < x^{LF} < x^B$*.*

Figure 4 depicts the Pareto frontier for a typical portfolio allocation problem. The risk allocation that is optimal for workers x^W is at the bottom right of the figure, and the allocation preferred by bankers is at the top left. The laissez faire equilibrium is indicated by the marker x^{LF}. As risk-taking x increases, we move upwards and left along the Pareto frontier. Along the way, expected bank profits rise for two reasons: first, because the risky technology offers higher returns; secondly because binding financial constraints redistribute from workers towards bankers, as we emphasized in Lemma 1. The welfare of workers declines because they are more and more hurt by binding financial constraints.

4.1 Market Incompleteness and the Distributive Conflict

To pinpoint why there is a distributive conflict over the level of risk-taking, it is instructive to consider the consequences of removing one of the financial market imperfections. First, suppose there is no financial constraint on bankers in period 1. In that case, the profits or losses of bankers do not affect how much capital can be intermediated to the real economy and workers are indifferent about the level of risk-taking – bank capital does not generate any pecuniary externalities. In such an economy, Fisherian separation holds: financial risk-taking and financial intermediation are orthogonal activities and $x^W = x^B = x^{FB} = 1$, i.e. the distributive conflict disappears.

Alternatively, suppose that there is a complete insurance market in period 0 in which bankers and workers can share the risk associated with there is the technology $\tilde{A}$, but there is still a financial constraint in period 1. In that case, workers will insure bankers against any capital shortfalls so that bankers can invest in the risky technology without imposing negative externalities on the real economy. By implication all agents are happy to invest the first-best amount $x^W = x^B = x^{FB} = 1$ in the risky technology, and the distributive conflict again disappears. Introducing a risk market in period 0 puts a formal price on risk. If both sets of agents can participate in this market, this provides workers with a channel through which they can both share risk and transmit their risk preferences to bankers.

Even if both financial market imperfections are present, the distributive conflict also disappears if the constraint always binds. In that case, bankers have the same risk exposure as workers and do not enjoy any asymmetric benefit on the upside since bank capital never exceeds the threshold where financial constraints are loose.[12] The distributive conflict is therefore generated by the combination of occasionally binding financial constraints and the lack of risk-sharing between bankers and workers. As argued in the introduction, both assumptions seem empirically highly relevant.

4.2 Financial Regulation

We interpret financial regulation in our framework as policy measures that affect risk-taking x. The unregulated equilibrium – in the absence of any other market distortions – is the laissez-faire equilibrium x^{LF}. If $x^{LF} \geq x^W$, then x^{LF} lies on the Pareto frontier, and financial regulation moves the economy along the frontier.[13]

[12] This is the case in many macro models that are linearized around a steady state with binding constraints. Appendix B.1 provides an analytic exposition of this case.

[13] Observe that a financial regulator would not find it optimal to change the leverage parameter ϕ in period 1 of our setup. The parameter cannot be increased because it stems from an underlying

The two simplest forms of financial regulation of risk-taking are:

1. Regulators may impose a ceiling on the risk-taking of individual bankers such that $x^i \leq \bar{x}$ for some $\bar{x} < x^{LF}$. This type of regulation closely corresponds to capital adequacy regulations as it limits the amount of risk-taking per dollar of bank capital.

2. Regulators may impose a tax τ^x on risk-taking x^i so as to modify the optimality condition for the risk-return trade-off of bankers to $E[\pi_1 \cdot (\tilde{A} - \tau^x - 1)] = 0$. Such a tax can implement any level of risk-taking $x \in [0, 1]$. For simplicity, assume that the tax revenue is rebated to bankers in lump-sum fashion.

Financial regulators can implement any risk allocation $\bar{x} \leq x^{LF}$ by imposing $\bar{x}$ as a ceiling on risk-taking or by imposing an equivalent tax on risk-taking $\tau^x \geq 0$. As emphasized in the discussion of Proposition 3, $x^{LF} \geq x^W$ holds for a wide range of parameters, and always holds in the plausible case $e^* < 1$, i.e. when the economy is ex ante well-capitalized. For the remainder of this section, we assume that $x^W < x^{LF}$. In this case the distributive implications are straightforward:

Corollary 4 (Redistributive Effects of Financial Regulation) *Tightening regulation by lowering $\bar{x}$ or raising τ^x increases worker welfare and reduces banker welfare for any $\bar{x} \in \left[x^W, x^{LF}\right]$.*

Conversely, financial deregulation increases the ceiling $\bar{x}$ and redistributes from workers to bankers.

Scope for Pareto-Improving Deregulation An interesting question is whether there exists a mechanism for Pareto-improving deregulation given additional instruments for policymakers than the regulatory measures on x described in Corollary 4. Such a mechanism would need to use some of the gains from deregulation obtained by bankers to compensate workers for the losses they suffer during credit crunches.

First, consider a planner who provides an uncontingent lump-sum transfer from bankers to workers in period 1 to compensate workers for the losses from deregulation. The marginal benefit to workers is $1 - E\left[w'(e)\right]$, i.e. workers would obtain a direct marginal benefit of 1 in all states of nature, but in constrained states they would be hurt by a tightening of the financial constraint which reduces their wages by $w'(e)$. The uncontingent transfer thus entails efficiency losses from tightening the constraints on bankers. The planner needs to weigh the redistributive benefit of any transfer against the cost of the distortion introduced. This creates a constrained Pareto frontier along which the trade-off between the welfare of the two agents is less

moral hazard problem and banks would default or deviate from their optimal behavior. Similarly, it is not optimal to decrease ϕ because this would tighten the constraint on financial intermediation without any corresponding benefit.

favorable than the original Pareto frontier. Compensating workers with an uncontingent payment without imposing these efficiency costs would require that the planner have superior enforcement capabilities to extract payments from bankers in excess of the financial constraint (3), which are not available to private markets.

Alternatively, consider a planner who provides compensatory transfers to workers contingent on states of nature in which bankers are unconstrained, i.e. in states in which they make high profits from the risky technology $\tilde{A}$. This would avoid efficiency costs but would again require that the planner can engage in state-contingent transactions that are not available via private markets. (It can be argued that this type of transfer corresponds to proportional or progressive profit taxation.)

In short, the planner can only achieve a Pareto improvement if she is either willing to provide transfers at the expense of reducing efficiency, or if she can get around one of the two market imperfections in our framework, i.e. mitigate either the financial constraint (3) or the incompleteness of risk markets.

5 Risk-Taking and Redistribution

We extend our baseline model to analyze the redistributive implications of four factors that are commonly viewed as reasons for risk-taking in the financial sector: agency problems, market power, financial innovation, and bailouts.

5.1 Asymmetric Compensation Schemes

It is frequently argued that asymmetric compensation schemes provide managers of financial institutions with excessive risk-taking incentives and that this may have played an important role in the build-up of risk before the financial crisis of 2008/09. To illustrate this mechanism, consider a stylized model of an incentive problem between bank owners and bank managers and analyze the distributive implications.

Assume that bank owners have to hire a new set of agents called bank managers to conduct their business. Bank managers choose an unobservable level of risk-taking x in period 0. Bank owners are able to observe the realization of profits and bank capital e in period 1 and to instruct managers to allocate any bank capital up to e^* in financial intermediation, and managers carry any excess $\max\{0, e - e^*\}$ in a storage technology. Financial intermediation versus storage can be viewed as representative of lending to real projects versus financial investments, or commercial banking versus investment banking.

Suppose that bank managers do not have the ability to commit to exert effort in period 1 and can threaten to withdraw their monitoring effort for both bank loans and storage in period 1. If they do not monitor, the returns on intermediation and storage (real projects and financial investments) are diminished by a fraction ε and $\delta\varepsilon$ respectively, where $\delta > 1$. In other words, the returns to financial investments are more sensitive to managerial effort than real investments. An alternative interpretation would be along the lines of Jensen (1986) that free cash provides managers with greater scope to abuse resources.

Assuming that managers have all the bargaining power, and given a symmetric equilibrium, the threat to withdraw their effort allows managers to negotiate an incentive payment from bank owners of

$$p\left(e^{i},e\right)=\varepsilon\min\left\{\pi\left(e^{i},e\right),\pi\left(e^{*},e^{*}\right)\right\}+\delta\varepsilon\max\left\{0,e^{i}-e^{*}\right\} \tag{15}$$

The marginal benefit of bank capital for an individual manager is $p_1(e,e)=\varepsilon\pi_1(e,e)$ for $e<e^*$ and $p_1(e,e)=\delta\varepsilon\pi_1(e,e)=\delta\varepsilon$ for $e\geq e^*$. Since financial investments deliver a greater incentive payment, the payoff of managers is more convex than the payoff of banks $\pi(e,e)$, and managers benefit disproportionately from high realizations of bank capital. Comparing this extension to our benchmark setup, $\Pi(x)$ is now the joint surplus of bank owners and managers, and the two functions $\Pi(x)$ and $W(x)$ remain unchanged compared to our earlier framework – the only thing that changes is the level of x that will be chosen by bank managers.

Managers internalize the asymmetric payoff profile when they choose the level of risk-taking in period 0. They maximize $E[p(e^i,e)]$ where $e^i=\tilde{A}x^i+1-x^i$. It is then straightforward to obtain the following result:

Proposition 5 (Agency Problems and Risk-Taking) *(i) The optimal choice of risk-taking of bank managers exceeds the optimal choice x^{LF} in our benchmark model if the payoff function of managers is asymmetric $\delta>1$.*

(ii) If $x^W\leq x^{LF}$, the expected welfare of workers is a declining function of δ.

5.2 Financial Institutions with Market Power

Assume that there is a finite number n of identical bankers in the economy who each have mass $\frac{1}{n}$. Banker i internalizes that his risk-taking decision x^i in period 0 affects aggregate bank capital $e=\frac{1}{n}e^i+\frac{n-1}{n}e^{-i}$, where e^{-i} captures the capital of the other bankers in the economy. For a given e, assume that bankers charge the competitive market interest rate $R(e)$ in period 1.[14] Our results are summarized in Proposition 6.

Proposition 6 *The optimal risk allocation x^n of bankers is a declining function of the number n of banks in the market, and $x^1=x^B\geq x^\infty=x^{LF}$, with strict inequality excepting corner solutions.*

[14]By contrast, if bankers interacted in Cournot-style competition in the period 1 market for loans, they would restrict the quantity of loans provided for a given amount of bank equity e^i to $\min\left\{k\left(e^i\right),k^{*n}\right\}$ where $k^{*n}=k^*\left(\frac{n-(1-\alpha)}{n}\right)^{\frac{1}{1-\alpha}}$ to increase their scarcity rents. We do not consider this effect in order to focus our analysis on the period 0 risk-taking effects of market power.

Intuitively, bankers with market power internalize that additional equity when the economy is constrained reduces their lending spreads. This counteracts the precautionary motive to carry extra capital into constrained states of nature. Our example illustrates that socially excessive risk-taking is an important dimension of non-competitive behavior by banks.

5.3 Financial Innovation

An important manifestation of financial innovation is to allow financial market players to access new investment opportunities, frequently projects that are characterized by both higher risk and higher expected returns. For example, financial innovation may enable bankers to invest in new activities, as made possible by the 1999 repeal of the 1933 Glass-Steagall Act, or to lend in new areas, to new sectors or to new borrowers, as during the subprime boom of the 2000s.

Our setup can formally capture this type of financial innovation by expanding the set of risky assets to which bankers have access in period 0. For a simple example, assume an economy in which bankers can only access the safe investment project in period 0 before financial innovation takes place, and that financial innovation expands the set of investable projects to include the risky project with stochastic return $\tilde{A}$. Furthermore, assume that $e^* < 1$, i.e. the safe return in period 0 generates sufficient period 1 equity for bankers to intermediate the first-best level of capital. The pre-innovation equilibrium corresponds to $x = 0$ in our benchmark setup and this maximizes worker welfare.

Example 7 (Distributive Effects of Financial Innovation) *In the described economy, expanding the set of investment projects to include $\tilde{A}$ increases banker welfare but reduces worker welfare.*

After financial innovation introduces the risky project, bankers allocate a strictly positive fraction of their endowment $x^{LF} > 1 - e^*$ to the risky project and incur binding financial constraints in low states of nature. This is their optimal choice because the expected return $E[\tilde{A}] > 1$ delivers a first-order benefit over the safe return, but bankers perceive the cost of being marginally constrained as second-order since $\pi_1(e^i, e)$ is continuous at e^*. Worker welfare, on the other hand, unambiguously declines as a result of the increased risk-taking.

This illustrates that financial innovation that increases the set of investable projects so as to include more high-risk/high-return options may redistribute from workers to bankers, akin to financial deregulation, even though total surplus may be increased. The problem in the described economy is that workers would be happy for bankers to increase risk-taking if they could participate in both the upside and the downside via complete insurance markets. Restrictions on the risk-taking activities of banks, e.g. via regulations such as the Volcker rule, may benefit workers by acting as a second-best device to complete financial markets. In the example described above this would be the case. Naturally, there are also some financial innovations that may increase worker welfare. In our framework, this may be the case for example for increases in ϕ, i.e. relaxations of the commitment problem of bankers.

5.4 Bailouts

Bailouts have perhaps raised more redistributive concerns than any other form of public financial intervention. This is presumably because they involve redistributions in the form of explicit transfers that are more transparent than other implicit forms of redistribution.

However, the redistributive effects of bailouts are both more subtle and potentially more pernicious than what is suggested by focusing on the direct fiscal cost. Ex post, i.e. once bankers have suffered large losses and the economy experiences a credit crunch, bailouts may actually lead to a Pareto improvement so that workers are better off by providing a transfer. However, ex-ante, bailout expectations increase risk-taking. This redistributes surplus from workers to the financial sector in a less explicit and therefore more subtle way, as emphasized throughout this paper.

Workers in our model find it ex-post collectively optimal to provide bailouts to bankers during episodes of severe capital shortages since this mitigates the credit crunch and its adverse effects on the real economy. Given an aggregate bank capital position e in period 1, the following policy maximizes ex-post worker welfare:[15]

Lemma 8 (Optimal Bailout Policy) *If aggregate bank capital in period* 1 *is below a threshold* $0 < \hat{e} < e^*$*, workers find it collectively optimal to provide lump-sum transfer* $t = \hat{e} - e$ *to bankers. The threshold* $\hat{e}$ *is determined by the expression* $w'(\hat{e}) = 1$ *or*

$$\hat{e} = (1-\alpha)\left[1-(1-\phi)\alpha\right]^{\frac{\alpha}{1-\alpha}} e^* \tag{16}$$

The intuition stems from the pecuniary externalities of bank capital on wages: increasing bank capital via lump-sum transfers relaxes the financial constraint of bankers and enables them to intermediate more capital, which in turn expands output and increases wages. As long as $e < \hat{e}$, the cost of a transfer on workers is less than the collective benefit in the form of higher wages.

We illustrate our findings in Figure 5. The threshold $\hat{e}$ below which bankers receive bailouts is indicated by the left dotted vertical line. Panel 1 shows bailouts $t(e)$ and welfare of workers and bankers as a function of bank capital. Bailouts are positive but decrease to zero over the interval $[0, \hat{e}]$. Within this interval, they stabilize the profits of bankers at the level $\pi(\hat{e})$. The welfare of workers is increasing at slope 1 since each additional dollar of bank capital implies that the bailout is reduced by one

[15] This section focuses on bailouts in the form of lump-sum transfers. Appendix B.3 shows that our results apply equally if bailouts are provided via emergency lending or equity injections on subsidized terms.

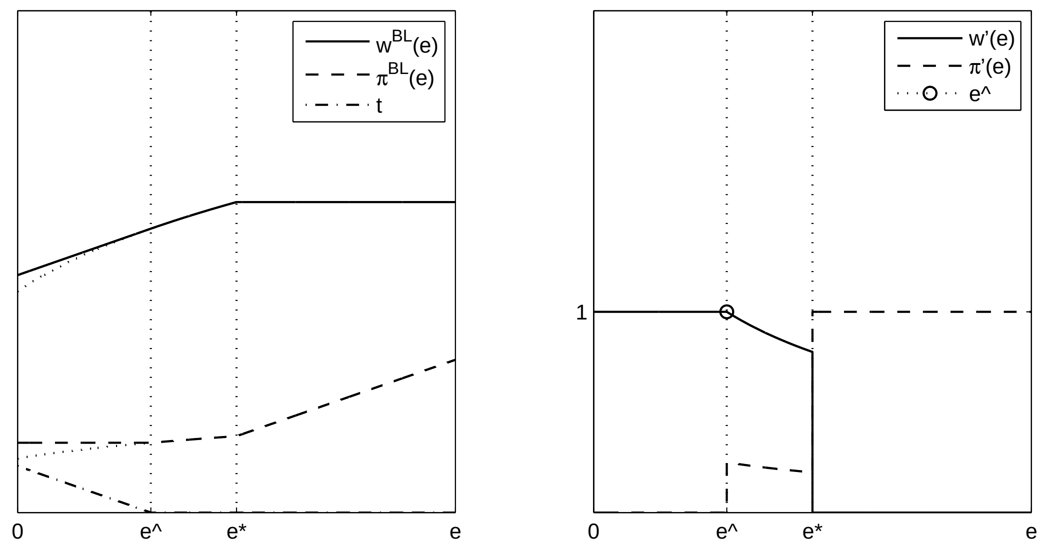

Figure 5: Welfare and marginal value of bank capital under bailouts.

dollar. Bailouts therefore make the payoff functions of all agents less concave and, in the case of bankers, locally convex.

Panel 2 of Figure 5 depicts the marginal welfare effects of bank equity under bailouts. The marginal benefit for workers $w^{BL\prime}(e)$ is 1 within the bailout region $e < \hat{e}$, since each additional dollar of bank equity reduces the size of the required bailout that they inject into bankers by a dollar. In fact, we can determine the level of $\hat{e}$ by equating the marginal benefit of bank capital to workers in the absence of bailouts, corresponding to the downward-sloping dotted line $w^{BL\prime}(e) = (1 - \alpha) F_k$ in the figure, to the marginal cost which is unity. This point is marked by a circle in the figure.

Bailouts constitute straight transfers from workers to bankers, but generate a Pareto improvement for $e < \hat{e}$ because they mitigate the market incompleteness that is created by the financial constraint (3) and that prevents bankers from raising deposit finance and intermediating capital to the productive sector. At the margin, each additional unit of bailout generates a surplus $F_k(e, 1) - 1$, of which $w'(e) - 1$ accrues to workers and $\pi'(e)$ to bankers. For the last marginal unit of the bailout, the benefit to workers is $w'(\hat{e}) - 1 = 0$ – they are indifferent between providing the last unit or not. However, the marginal benefit to bankers for the last unit is strictly positive $\pi'(\hat{e}) = \frac{(1-\phi)\alpha}{1-\alpha}$.[16]

[16] For the remainder of our analysis of bailouts, we assume that the parameters α, ϕ and A are such that $\hat{e} < 1$ (or, equivalently, $e_0 > \hat{e}$). This is a mild assumption that guarantees that the banking sector will not require a bailout if the period 0 endowment is invested in the safe project. It also implies that bailouts are not desirable in states of nature in which the risky project yields higher returns than the safe project. This is reasonable because typically bailouts occur only if risky investments have gone bad.

Period 0 Risk-Taking Optimal discretionary bailouts impose a ceiling on the market interest rate $R^{BL}(e) \leq R(\hat{e}) = \frac{1}{1-(1-\phi)\alpha}$ since they ensure that aggregate capital investment is at least $k \geq k(\hat{e})$ at all times. This mitigates the precautionary incentives of bankers and increases their risk-taking, corresponding to an "income effect" of bailouts. This effect exists even if bailouts are provided in the form of lump-sum transfers and do not distort the optimality conditions of bankers. The adverse incentive effects of bailouts are aggravated if they are conditional on individual bank capital e^i, which distorts the risk-taking incentives of bankers, corresponding to a "substitution effect" of bailouts.[17] Denoting the amount of their endowment that bankers allocate to the risky project by x^{BL}:

Lemma 9 (Risk-Taking Effects of Bailouts) *Introducing bailouts increases period 0 risk-taking, $x^{BL} > x^{LF}$.*

Intuitively, bailouts reduce the tightness of constraints and therefore the returns on capital π_1 in low states of nature. This lowers the precautionary incentives of bankers and induces them to take on more risk, even though the bailouts are provided in a lump-sum fashion. Observe that this effect is similar to the effects of any countercyclical policy or any improvement in risk-sharing via markets.[18]

Redistributive Effects The welfare effects of introducing bailouts on bankers and workers can be decomposed into two parts, the change in expected welfare from introducing bailouts for a given level of risk-taking x^{BL}, corresponding to the market completion effect of bailouts, and the change in the level of risk-taking, corresponding to the incentive effects of bailouts:[19]

$$\Delta\Pi = \left[\Pi^{BL}(x^{BL}) - \Pi(x^{BL})\right] + \left[\Pi(x^{BL}) - \Pi(x^{LF})\right] \tag{17}$$

$$\Delta W = \underbrace{\left[W^{BL}(x^{BL}) - W(x^{BL})\right]}_{\text{market completion}} + \underbrace{\left[W(x^{BL}) - W(x^{LF})\right]}_{\text{incentive effect}} \tag{18}$$

Corollary 10 (Distributive Effects of Bailouts) *(i) Bankers always benefit from introducing bailouts.*

(ii) Workers benefit from the market completion effect of bailouts, but are hurt by the incentive effects of bailouts if $x^W < x^{LF}$.

---

[17] This effect is well-understood in the literature on bailouts and operates in the same direction as the income effect. For details on this case, see Appendix B.4

[18] Our framework does not explicitly account for bankruptcy because $\tilde{A}$ is bounded at 0; if period 0 investments could lead to bankruptcy, there may be an additional risk-taking incentive for banks.

[19] The first term for workers could be further separated into a negative term corresponding to the transfers that they make, and a larger positive term corresponding to the resulting increase in wages for given x.

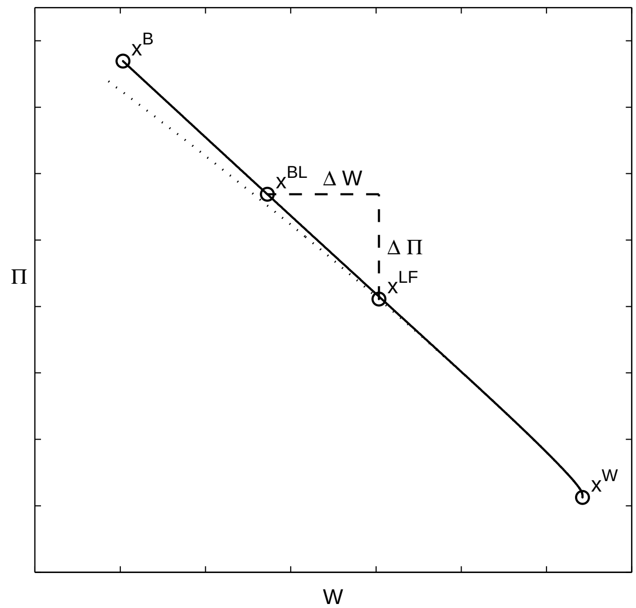

Figure 6: Pareto frontier under bailouts

We illustrate our findings in Figure 6. The figure shows how the Pareto frontier depicted in Figure 4 is affected by the introduction of bailouts. The new Pareto frontier (solid line) is shifted out compared to the old frontier (dotted line) at its left end, i.e. $\Pi^{BL}(x) > \Pi(x)$ and $W^{BL}(x) > W(x)$ for all $x > x^W$ but is unchanged at $x = x^W$ as long as $e^* < 1$ (which holds in our parameterization). The shift in the frontier is thus biased towards bankers and the introduction of bailouts constitutes banker-biased technological change. In our figure, risk-taking increases significantly, and banker welfare rises by $\Delta\Pi$ whereas worker welfare falls by ΔW.

Although the market completion effect is positive for both sets of agents, the increase in risk-taking benefits bankers at the expense of workers because $W'(x) < 0$. Bailouts increase banker welfare both directly because of the transfers received from workers and indirectly as a result of the higher risk-taking. Haldane (2010) emphasizes that the social cost of the 2008/09 credit crunch exceeded the fiscal cost of bailouts by an order of magnitude. This suggests that the effects of bailouts on risk-taking incentives may be far costlier to workers than the direct fiscal cost.

6 Conclusions

The central finding of our paper is that financial regulation has important redistributive implications. The majority of the literature on financial regulation focuses on the efficiency implications of financial regulation and disregards redistributive effects. Welfare is typically determined by a planner who picks the most efficient allocation under the assumption that the desired distribution of resources between different agents can be implemented independently.

We find that deregulation benefits Wall Street by allowing for greater risk-taking and higher expected profits. However, the downside is that greater risk-taking leads to a greater incidence of losses that are sufficiently large to trigger a credit crunch. If the financial sector is constrained in its intermediation activity, Main Street obtains less credit and invests less, lowering output and the marginal product of labor, which imposes negative externalities on wage earners. The degree of financial risk-taking and financial regulation therefore has first-order redistributive implications.

There are a number of issues that we leave for future analysis: First, since risk-taking is profitable, financial regulation generates large incentives for circumvention. If the regulatory framework of a country covers only one part of its financial system, the remaining parts will expand. In the US, for example, the shadow financial system grew to the point where it constituted an essential part of the financial sector, but it was largely unregulated and could engage in high levels of risk-taking. This made the sector vulnerable to the losses experienced during the 2008 financial crisis. And since the sector had become an essential part of Wall Street, its losses generated strong adverse effects on Main Street.

Second, our results bring up the question of what types of financial innovation and financial regulation are most likely to increase the welfare of both Wall Street and Main Street so as to achieve a Pareto improvement. Our findings suggest two promising directions that correspond to alleviating the two main market imperfections in our framework: (i) innovations or regulatory interventions that increase risk-sharing between the two sectors on both the upside and the downside. This reduces the distributive conflict over risk-taking because it allows for a more equitable sharing of the gains from financial risk-taking. (ii) innovations or regulatory interventions that reduce the likelihood of hitting binding constraints, for example better capitalized banks, reduce the likelihood that financial risk-taking will lead to credit crunches that have real implications. This reduces the distributive conflict because it alleviates the negative externalities from Wall Street to Main Street during such episodes.

Third, the paper mainly discusses the effects of financial risk-taking, but if the financial sector designs innovative ways of financing risky investment opportunities on Main Street and of sharing the associated risks so as to protect the economy from credit crunches, it is likely that both sectors benefit. An example would be innovations that increase the availability of venture capital. Thus it is important for regulators to distinguish between financial risk-taking and intermediating risk capital to the real economy.

References

Admati, A.R., DeMarzo P.M., Hellwig, M.F., Pfleiderer, P., 2010. Fallacies, irrelevant facts, and myths in the discussion of capital regulation: why bank equity is not expensive. Stanford GSB Research Paper No. 2065.

Adrian, T., Moench, E., and Shin, H. S., 2010. Macro Risk Premium and Intermediary Balance Sheet Quantities. IMF Economic Review 58 (1), 179–207.

Benigno, G., Chen, H., Otrok, C., Rebucci, A., and Young, E.R., 2012. Optimal policy for macro-financial stability. Manuscript, LSE.

Bernanke, B., Gertler, M., 1989. Agency costs, net worth and business fluctuations. American Economic Review 79 (1), 14–31.

Bianchi, J., Mendoza, E., 2010. Overborrowing, financial crises, and 'macroprudential' taxes. NBER Working Paper w16091.

Brunnermeier, M.K., Pedersen, L.H., 2009. Market liquidity and funding liquidity. Review of Financial Studies 22 (6), 2201–2238.

Caballero, R.J., Lorenzoni, G., 2014. Persistent appreciations and overshooting: a normative analysis. IMF Economic Review 62 (1), 1–47.

Campbell, J.R., Hercowitz, Z., 2009. Welfare implications of the transition to high household debt. Journal of Monetary Economics 56 (1), 1–16.

Freixas, X., Rochet, J., 2008. Microeconomics of banking, 2nd edition. Cambridge, MA: MIT Press.

Furceri, D., Florence, J., Loungani, P., 2014. The distributional consequences of capital account liberalization. Forthcoming, IMF Working Paper.

Gertler, M., Karadi, P., 2011. A model of unconventional monetary policy. Journal of Monetary Economics 58, 17–34.

Gertler, M., Kiyotaki, N., 2010, Financial intermediation and credit policy in business cycle analysis. Handbook of Monetary Economics 3, 547–599.

Gersbach, H., Rochet, J., 2012. Aggregate investment externalities and macroprudential regulation. Journal of Money, Credit and Banking 44 (s2), 73–109.

Haldane, A., 2010. The $100 billion question. Revista de Economia Institucional 12 (22), 83–110.

Holmstrom, B., Tirole, J., 1998. Private and public supply of liquidity. Journal of Political Economy 106 (1), 1–40.

Jeanne, O., Korinek, A., 2010a. Excessive volatility in capital flows: a Pigouvian taxation approach. American Economic Review, 403–407.

Jeanne, O., Korinek, A., 2010b. Managing credit booms and busts: a Pigouvian taxation approach. NBER Working Paper 16377.

Jeanne, O, Korinek, A., 2012. Macroprudential regulation versus mopping up after the crash. NBER Working Paper 18675.

Jensen, M.C., 1986. Agency costs of free cash flow, corporate finance, and takeovers. American Economic Review 76 (2), 323–329.

Kaplan, S.N., Rauh, J., 2010. Wall Street and Main Street: what contributes to the rise in the highest incomes? Review of Financial Studies 23 (3), 1004–1050.

Karabarbounis, L., Neiman, B., 2014. The global decline of the labor share. Quarterly Journal of Economics 129 (1), 61–103.

Kennickell, A.B., 2013. Ponds and streams: wealth and income in the U.S., 1989 to 2007. Finance and Economics Discussion Series, Federal Reserve Board, Washington, DC.

Kiyotaki, N., Moore, J.H., 1997. Credit cycles. Journal of Political Economy 105 (2), 211–248.

Korinek, A., 2011. Systemic risk-taking: amplification effects, externalities, and regulatory responses. ECB Working Paper 1345.

Korinek, A., 2013. Financial innovation for rent extraction. Manuscript, Johns Hopkins University.

Korinek, A., Mendoza, E., 2014. From sudden stops to Fisherian deflation: quantitative theory and policy implications. Annual Review of Economics 6, 299–332.

Kreamer, J., 2014. Household debt, unemployment, and slow recoveries. Manuscript, University of Maryland.

Larrain, M., 2014. Capital account liberalization and wage inequality. Manuscript, Columbia University.

Lorenzoni, G., 2008. Inefficient credit booms. Review of Economic Studies 75 (3), 809–833.

Miles, D., Yang, J., Marcheggiano, G., 2012. Optimal bank capital. Economic Journal 123 (567), 1–37.

Philippon, T., Reshef, A., 2012. Wages and human capital in the U.S. financial industry: 1909–2006. Quarterly Journal of Economics 127 (4), 1551–1609.

Philippon, T., Reshef, A., 2013. An international look at the growth of modern finance. Journal of Economic Perspectives 27 (2), 73–96.

Reinhart, C., Rogoff, K., 2009. This time is different: eight centuries of financial folly. Princeton University Press.

Sandri, D., Valencia, F., 2013. Financial crises and recapitalizations. Journal of Money, Credit and Banking 45 (2), 59–86.

A Appendix: Proofs

Proof of Lemma 1. We take the left-sided limit of the derivative of the payoff functions of bankers and workers $\pi(e^* - \varepsilon) + \varepsilon$ and $w(e^* - \varepsilon)$ as $\varepsilon \to 0$ to find

$$\begin{aligned}\lim_{e \to e^{*-}} -\pi'(e) + 1 = \lim_{e \to e^{*-}} (1-\alpha)\,k'(e) &= \frac{1-\alpha}{1-\alpha\phi} \\ \lim_{e \to e^{*-}} -w'(e) = \lim_{e \to e^{*-}} -(1-\alpha)\,k'(e) &= -\frac{1-\alpha}{1-\alpha\phi}\end{aligned}$$

The marginal effect on total surplus is the sum of the two, $1 - s' = 1 - \pi' - w'$, and is zero at a first-order approximation. ■

Proof of Proposition 3. We first show that the marginal functions $\Pi'(x)$, $\Pi_1(x^i, x)$, and $W'(x)$ are strictly decreasing in x by differentiating each with respect to x,

$$\begin{aligned}\Pi''(x) &= \int_0^{A^*} \left(\tilde{A}-1\right)^2 \frac{(1-\phi)\alpha F_{kk}}{(1-\alpha\phi F_k)^3} dG(\tilde{A}) < 0 \\ \frac{d}{dx}\Pi_1(x^i, x) &= \int_0^{A^*} \left(\tilde{A}-1\right)^2 \frac{(1-\phi)F_{kk}}{(1-\phi F_k)^2(1-\alpha\phi F_k)} dG(\tilde{A}) < 0 \\ W''(x) &= \left[\frac{(1-\alpha)}{(1-\phi)\alpha}\right] \Pi''(x) < 0\end{aligned}$$

Note that if it is indeed the case that $x^W < x^B$, then part (ii) of the proof follows immediately from this fact.

Next we show that $x^{LF} < x^B$ at an interior solution. At the point x^{LF} we have $\Pi_1 = 0$. Then we find

$$\Pi'(x^{LF}) = \Pi'(x^{LF}) - \Pi_1(x^{LF}, x^{LF}) = -\int_0^{A^*} \frac{(1-\alpha)(1-\phi)(\tilde{A}-1)F_k}{(1-\phi\alpha F_k)(1-\phi F_k)} dG(\tilde{A})$$

Observe that the term $\frac{F_k}{(1-\phi\alpha F_k)(1-\phi F_k)}$ is strictly increasing in F_k. Now we define $\bar{R}$ as follows. If $A^* \leq 1$, so that the term $(\tilde{A}-1) < 0$ over the entire interval, we let $\bar{R}$ be the value of F_k when $\tilde{A} = A^*$. If instead we have $A^* > 1$, then let $\bar{R}$ be the value of F_k at $\tilde{A} = 1$. Then since F_k is decreasing in $\tilde{A}$, we have

$$-\int_0^{A^*} \frac{(1-\alpha)(1-\phi)(\tilde{A}-1)F_k}{(1-\phi\alpha F_k)(1-\phi F_k)} dG(\tilde{A}) > -\int_0^{A^*} \frac{(1-\alpha)(1-\phi)(\tilde{A}-1)F_k}{\left(1-\phi\alpha\bar{R}\right)(1-\phi F_k)} dG(\tilde{A})$$

Recall that at x^{LF} we have $\Pi_1 = 0$. We can write this as

$$\int_0^{A^*} (\tilde{A}-1)\frac{(1-\phi)F_k}{1-\phi F_k} dG(\tilde{A}) + \int_{A^*}^{\infty} (\tilde{A}-1) dG(\tilde{A}) = 0$$

Then since $\int_{A^*}^{\infty}(\tilde{A}-1)dG(\tilde{A})>0$, we must have $\int_0^{A^*}(\tilde{A}-1)\frac{(1-\phi)F_k}{1-\phi F_k}dG(\tilde{A})<0$. Thus we have

$$\Pi'(x^{LF})>-\frac{(1-\alpha)}{(1-\phi\alpha\bar{R})}\int_0^{A^*}\left(\tilde{A}-1\right)\frac{(1-\phi)F_k}{(1-\phi F_k)}dG(\tilde{A})>0$$

Thus we have $x^{LF}<x^B$. If $e^*\leq 1$ then $x^W=1-e^*$ because workers prefer avoiding any constraints whereas $x^{LF}>1-e^*$ because individual bankers would like to expose themselves to at least some constraints; therefore $x^W<x^{LF}$.

Finally, we show that $x^W<x^B$ for interior solutions to prove (i). Observe that

$$\Pi'(x)-\frac{(1-\phi)\alpha}{1-\alpha}W'(x)=\int_{A^*}^{\infty}\left(\tilde{A}-1\right)dG(\tilde{A})>0$$

Since at an interior solution we have $W'(x^W)=0$, this implies $\Pi'(x^W)>0$, and so $x^B>x^W$. ■

Proof of Proposition 5. For (i), observe that we can write

$$p(e^i,e)=\epsilon\pi(e^i,e)+\epsilon\left(\delta-1\right)\left(e^i-e\right)\mathbb{I}_{e^i\geq e^*}$$

where $\mathbb{I}_{e^i\geq e^*}$ is an indicator variable that is equal to 1 when $e^i\geq e^*$ and 0 otherwise. The preferred choice of x by managers, call it x^A, satisfies $P_1(x)=E\left[(\tilde{A}-1)p_1(e^i,e)\right]\geq 0$. We can write this as

$$P_1(x)=\epsilon\Pi_1(x)+\epsilon\left(\delta-1\right)E\left[(\tilde{A}-1)\mathbb{I}_{e^i\geq e^*}\right]$$

where $\Pi_1(x)=E\left[(\tilde{A}-1)\pi_1(e^i,e)\right]$ is the owner's first-order condition. The second term is strictly positive because

$$E\left[(\tilde{A}-1)\mathbb{I}_{e^i\geq e^*}\right]=E\left[\tilde{A}-1|e^i\geq e^*\right]Pr(e^i\geq e^*)$$

Since e^i is strictly increasing in $\tilde{A}$, $E[\tilde{A}-1|e^i\geq e^*]$ is the expected value of the upper portion of a random variable, and so is strictly greater than $E[\tilde{A}-1]$, which by assumption is strictly positive. Therefore we have $\Pi_1(x^{LF})>0$, and so $x^A>x^{LF}$.

To prove (ii), we begin by showing that x^A is strictly increasing in δ. Differentiating $P_1(x)$ with respect to δ yields $\epsilon E\left[(\tilde{A}-1)\mathbb{I}_{e^i\geq e^*}\right]$, which is strictly positive. At the old preferred level of x, we now have $P_1(x)>0$, and so x^A will increase. Now we observe that increasing x for $x>x^W$ will always make workers worse off. Then since $x^W<x^{LF}<x^A$, increasing δ will make workers worse off. ■

Proof of Proposition 6. The marginal valuation of bank capital is now

$$\pi_1^{i,n}\left(e^i,e^{-i}\right)=\begin{cases}\frac{1}{n}\pi'\left(e\right)+\frac{n-1}{n}\pi_1^i\left(e^i,e\right) & \text{for } e<e^{*,n}\\ 1 & \text{for } e\geq e^{*,n}\end{cases}$$

This falls in between the marginal value of bank capital for the sector as a whole and for a competitive banker, i.e. $\pi' < \pi_1^{i,n} < \pi_1^i$.

Since we have $\pi_1^{i,n}(e^i, e) = \pi_1^i + \frac{1}{n}(\pi' - \pi_1^i)$, we can write the optimality condition for one of n large firms as

$$\Pi_1^{i,n} = \Pi_1(x) + \frac{1}{n}(\Pi' - \Pi_1) = 0$$

We immediately see that for $n = 1$, this reduces to $\Pi' = 0$, which has solution x^B, and for $n \to \infty$ this reduces to $\Pi_1 = 0$, which has solution $x^{LF} < x^B$.

Now suppose that for a given n, we have $x^n \in \left(x^{LF}, x^B\right)$. At x^n, we differentiate the optimality condition w.r.t. n and find

$$\frac{d}{dn}\Pi_1^{i,n} = -\frac{1}{n^2}(\Pi' - \Pi_1)$$

Since Π_1 and Π' are both strictly decreasing in x, and since they are zero at x^{LF} and $x^B > x^{LF}$ respectively, in the interval (x^{LF}, x^B) we have $\Pi_1 < \Pi'$. Therefore for higher n we have $\frac{d}{dn}\Pi_1^{i,n} < 0$, and so x^n is decreasing in n. ■

Proof of Lemma 9. The welfare maximization problem of bankers under bailouts is

$$\max_{x^i \in [0,1]} \Pi^{BL}\left(x^i, x\right) = E\left[\pi^{BL}\left(e^i + t(e), e + t(e)\right)\right]$$

where $e^i = 1 - x^i + \tilde{A}x^i$ and $e = 1 - x + \tilde{A}x$ ($e^i = e$ in equilibrium). Let $\hat{A}$ be the level of $\tilde{A}$ that achieves the bailout threshold $\hat{e}$. The first partial derivative of the function Π^{BL} evaluated at x^{LF} satisfies

$$\begin{aligned}
\Pi_1^{BL}\left(x^{LF}, x^{LF}\right) &= E\left[\left(\tilde{A} - 1\right)\pi_1^{BL}\left(e^i, e\right)\right] = \\
&= \pi_1(\hat{e}, \hat{e})\int_0^{\hat{A}}(\tilde{A} - 1)dG(\tilde{A}) + \int_{\hat{A}}^{\infty}(\tilde{A} - 1)\pi_1 dG(\tilde{A}) > \\
&> \int_0^{\hat{A}}(\tilde{A} - 1)\pi_1 dG(\tilde{A}) + \int_{\hat{A}}^{\infty}(\tilde{A} - 1)\pi_1 dG(\tilde{A}) = \Pi_1\left(x^{LF}, x^{LF}\right) = 0
\end{aligned}$$

Now we show why this inequality holds. First note that the second terms are identical and must be positive for $\Pi_1\left(x^{LF}, x^{LF}\right) = 0$ to hold. Thus if the first term in $\Pi_1^{BL}\left(x^{LF}, x^{LF}\right)$ is positive, we are done. Suppose it is negative, which implies $E[\tilde{A} - 1 | A \leq \hat{A}] < 0$. Then we need to show that

$$\int_0^{\hat{A}}(\tilde{A} - 1)\pi_1(\hat{e}, \hat{e})\,dG(\tilde{A}) > \int_0^{\hat{A}}(\tilde{A} - 1)\pi_1(e, e)dG(\tilde{A})$$

We can write this expression as $\int_0^{\hat{A}}(\tilde{A}-1)(\pi_1(\hat{e}, \hat{e}) - \pi_1)dG(\tilde{A}) > 0$, which is equivalent to $E[(\tilde{A} - 1)(\pi_1(\hat{e}, \hat{e}) - \pi_1) | \tilde{A} \leq \hat{A}] > 0$. This is the expectation of the product of two random variables, which equals

$$E\left[\tilde{A}-1|\tilde{A}\leq\hat{A}\right]\cdot E\left[\pi_1(\hat{e},\hat{e})-\pi_1|\tilde{A}\leq\hat{A}\right]+cov\left(\tilde{A}-1,\pi_1(\hat{e},\hat{e})-\pi_1|\tilde{A}\leq\hat{A}\right)$$

Since $\tilde{A}-1$ and $\pi_1(\hat{e},\hat{e})-\pi_1(e,e)$ are both strictly increasing in $\tilde{A}$ over the interval $[0,\hat{A})$, their covariance is strictly positive. Then since both $E[\pi_1(\hat{e},\hat{e})-\pi_1|\tilde{A}\leq\hat{A}]<0$ and $E[\tilde{A}-1|A\leq\hat{A}]<0$, this term is positive, and $\Pi_1^{BL}(x^{LF},x^{LF})>0$. Therefore individual bankers will choose to increase $x^{BL}>x^{LF}$ if there is a positive probability of bailouts. ■

Proof of Lemma 8. The welfare of workers who collectively provide a transfer $t\geq 0$ to bankers is given by $w(e+t)-t$. An interior optimum satisfies $w'(e+t)=1$. We define the resulting equity level as $\hat{e}=e+t$, which satisfies equation (16). Observe that $w'(e)$ is strictly declining from $w'(0)=1/\phi>1$ to $w'(e^*)=\frac{1-\alpha}{1-\phi\alpha}<1$ over the interval $[0,e^*]$ so that $\hat{e}$ is uniquely defined. If aggregate bank capital is below this threshold $e<\hat{e}$, workers find it collectively optimal to transfer the shortfall. If e is above this threshold, it does not pay off for workers to provide a transfer since $w'<1$ and the optimal transfer is given by the minimum $t=0$. ■

B Appendix: Variants of Baseline Model

B.1 Always Constrained Case

An interesting special case in which financial markets in period 0 are effectively complete is a two sector framework in which bankers own all the capital and workers own all the labor in the economy (i.e. there are no deposits $d=0$ and no storage). By implication, bankers invest all their equity into real capital $k=e$. Given a Cobb-Douglas production technology, the two sectors earn constant fractions of aggregate output so that $\pi(e)=\alpha F(e,1)$ and $w(e)=(1-\alpha)F(e,1)$ for $e=\tilde{A}x+(1-x)$. As long as the two sectors have preferences with identical relative risk aversion (in our benchmark model both have zero risk-aversion), the optimal level of risk-taking for bankers simultaneously maximizes total surplus and worker welfare:

$$\arg\max_x E[\pi(e)]=\arg\max_x E[F(e,1)]=\arg\max_x E[w(e)]$$

Bank capital still imposes pecuniary externalities on wages in this setting, but the pecuniary externalities under a Cobb-Douglas technology guarantee that both sets of agents obtain constant fractions of output, replicating the allocation under perfect risk-sharing. (Analytically, the constant capital and labor shares drop out of the optimization problem.) There is no distributive conflict.

B.2 Period 0 Production Function

This appendix generalizes our setup to a Cobb-Douglas production function that is symmetric across periods $t = 1$ and 2 of the form

$$\left[\tilde{A}_t x_t + 1 - x_t\right] F(k_t, \ell_t)$$

This allows us to account for the notion that the higher returns from risk-taking in the initial period are shared between workers and bankers.

We continue to assume that bankers choose the fraction x_t allocated to risky projects and firms choose the amount of capital invested k_t before the productivity shock $\tilde{A}_t$ is realized, i.e. in period $t-1$.

In period 0, bankers supply their initial equity e_0 to firms for physical capital investment so that $k_0 = e_0$. In period 1, the productivity shock $\tilde{A}_1$ is realized and firms hire $\ell = 1$ units of labor to produce output $\tilde{A}_1 F(e_0, 1)$. Bankers and workers share the productive output according to their factor shares,

$$\begin{aligned} e_1 &= \alpha \left[\tilde{A}_1 x_1 + 1 - x_1\right] F\left(e_0, 1\right) \qquad (19) \\ w_1 &= (1-\alpha) \left[\tilde{A}_1 x_1 + 1 - x_1\right] F\left(e_0, 1\right) \end{aligned}$$

where equation (19) represents the law-of-motion of bank capital from period 0 to period 1. Given the period 1 bank capital e_1, the economy behaves as we have analyzed in Section 3.1 in the main body of the paper, i.e. bankers and workers obtain profits and wages of $\pi(e_1)$ and $w(e_1)$. Observe that all agents are risk-averse with respect to period 2 consumption; therefore the optimal $x_2 \equiv 1$ and we can solve for all allocations as if the productivity parameter in period 2 was the constant $A_2 = E[\tilde{A}_2]$, as in our earlier analysis.

We express aggregate welfare of bankers and workers as a function of period 0 risk-taking x_1 as

$$\begin{aligned} \Pi(x_1) &= E\left\{\pi(e_1)\right\} \\ W(x_1) &= E\left\{w_1 + w(e_1)\right\} \end{aligned}$$

where e_1 and w_1 are determined by risk-taking and the output shock, as given by equation (19).

Observe that in addition to the effects of risk-taking on period 2 wages $w(e_1)$ that we investigated earlier, period 1 wages now depend positively on risk-taking x_1 because wages are a constant fraction $(1-\alpha)$ of output and greater risk leads to higher period 1 output since $E[\tilde{A}_1] > 1$. Bankers do not internalize either of the two externalities on period 1 and period 2 wages.

Assuming an interior solution for x_1 and noting that $\pi'(e_1) - 1 = (\alpha F_k - 1)k'(e_1)$, the optimal level of risk-taking for the banking sector x_1^B satisfies

$$\Pi'(x_1^B) = E\left[\left(\tilde{A}_1 - 1\right)\pi'(e_1)\right] =$$
$$= E\left[\tilde{A}_1 - 1\right] + \int_0^{\hat{A}_1}\left(\tilde{A}_1 - 1\right)(\alpha F_k - 1)\, k'(e_1) dG(\tilde{A}_1) = 0$$

The banking sector prefers more risk than workers if $W'(x_1^B) < 0$:

$$W'\left(x^B\right) = E\left\{\left[(1-\alpha)F\left(e_0, 1\right) + w'\left(e\right)\right]\left(\tilde{A} - 1\right)\right\}$$
$$= \int_0^{\hat{A}}\left[w'\left(e\right) - (1-\alpha)F\left(e_0, 1\right)(\alpha F_k - 1)\, k'(e_1)\right]\left(\tilde{A} - 1\right) dG(\tilde{A}_1)$$

where we subtracted the expression $(1-\alpha)F\left(e_0, 1\right)\Pi'(x_1^B) = 0$ in the second line, which is zero by the optimality condition of bankers.

Let us impose two weak assumptions that allow us to sign this expression. First, assume $\phi > \alpha$, i.e. leverage is above a minimum level that is typically satisfied in all modern financial systems (1.5 for the standard value of $\alpha = 1/3$), and secondly, that $\hat{A} < 1$, i.e. only low realizations of the productivity shock lead to credit crunches. Note that these two assumptions are sufficient but not necessary conditions.

Now observe that the first term under the integral, $w'(e)$, is always positive. To sign the second term, notice that $F_k(k, 1) \leq F_k(k(0), 1) = 1/\phi\ \forall\ e \geq 0$ and so the assumption $\phi > \alpha$ implies that $\alpha F_k - 1 < 0$. Furthermore, by the second assumption, the term $(\tilde{A} - 1)$ is negative since the integral is over the interval $[0, \hat{A}]$. As a result, the two conditions are sufficient to ensure that the expression is always negative and that workers continue to prefer less risk-taking than the banking sector.

Intuitively, our distributive results continue to hold when we account for production and wage earnings in both time periods because the distributive conflict stems from the asymmetric effects of credit crunches on bankers and workers, which are still present: workers are hurt by credit crunches but do not benefit from higher bank dividends in good times. Therefore workers prefer less risk-taking than bankers.

B.3 Different Forms of Bailouts

This appendix considers bailouts that come in the form of emergency lending and equity injections and shows that both matter only to the extent that they provide a subsidy (outright transfer in expected value) to constrained bankers that relaxes their financial constraint.[20]

[20] For a more comprehensive analysis of bank recapitalizations see e.g. Sandri and Valencia (2013). For a detailed analysis of the resulting incentives for rent extraction see Korinek (2013).

Emergency Lending A loan d^{BL} that a policymaker provides to constrained bankers on behalf of workers at an interest rate r^{BL} that is frequently subsidized, i.e. below the market interest rate $r^{BL} \leq 1$. Such lending constitutes a transfer of $\left(r^{BL}-1\right) d^{BL}$ in net present value terms.[21] Assuming that such interventions cannot relax the commitment problem of bankers that we described in Section 2.2, they are subject to the constraint

$$rd + r^{BL} d^{BL} \leq \phi Rk \tag{20}$$

Equity Injections provide constrained bankers with additional bank capital/equity q in exchange for a dividend distribution D, which is frequently expressed as a fraction of bank earnings. The equity injection constitutes a transfer of $q-D$ from workers to bankers in net present value terms. Assuming that the dividend payment is subject to the commitment problem of bankers that we assumed earlier, it has to obey the constraint

$$rd + D \leq \phi Rk \tag{21}$$

Given our assumptions, both types of bailouts are isomorphic to a lump-sum transfer t from workers to bankers.[22]

In the following lemma, we will first focus on an optimal lump-sum transfer and then show that the resulting allocations can be implemented either directly or via an optimal package of emergency lending or equity injection.

Lemma B1 (Variants of Bailouts) *Both workers and bankers are indifferent between providing the bailout via subsidized emergency loans such that $\left(1-r^{BL}\right) d^{BL}=t$ or via subsidized equity injections such that $q-D=t$. Conversely, emergency lending and/or equity injections that do not represent a transfer in net present value terms are ineffective in our model.*

Proof. Let us first focus on an emergency loan package described by a pair (r^{BL}, d^{BL}) that is provided to bankers by a policymaker on behalf of workers. Since the opportunity cost of lending is the storage technology, the direct cost of such a loan to workers is $(1-r^{BL})d^{BL}$. Bankers intermediate $k = e + d + d^{BL}$ where we substitute d from constraint (20) to obtain

$$k = \frac{e + \left(1-r^{BL}\right) d^{BL}}{1-\phi R\left(k\right)} = k\left(e + \left(1-r^{BL}\right) d^{BL}\right)$$

Therefore the emergency loan is isomorphic to a lump sum transfer $t = \left(1-r^{BL}\right) d^{BL}$ for bankers, workers and firms. For an equity injection that is described by a pair (q, D), an identical argument can be applied.

[21] In our framework, we assumed that default probabilities are zero in equilibrium. In practice, the interest rate subsidy typically involves not charging for expected default risk.

[22] Since labor supply is constant, a tax on labor would be isomorphic to a lump sum transfer.

These observations directly imply the second part of the lemma. More specifically, constraint (20) implies that an emergency loan of d^{BL} at an unsubsidized interest rate $r^{BL} = 1$ reduces private deposits by an identical amount $\Delta d = -d^{BL}$ and therefore does not affect real capital investment k. Similarly, constraint (21) implies that an equity injection which satisfies $q = D$ reduces private deposits by $\Delta d = -D$ and crowds out an identical amount of private deposits. ■

This captures an equivalence result between the two categories of bailouts – what matters for constrained bankers is that they obtain a transfer in net present value terms, but it is irrelevant how this transfer is provided. From the perspective of bankers who are subject to constraint (3), a one dollar repayment on emergency loans or dividends is no different from a one dollar repayment to depositors, and all three forms of repayment tighten the financial constraint of bankers in the same manner. An emergency loan or an equity injection at preferential rates that amounts to a one dollar transfer allows bankers to raise an additional $\frac{\phi R}{1-\phi R}$ dollars of deposits and expand intermediation by $\frac{1}{1-\phi R}$ dollars in total.

Emergency loans or equity injections that are provided at 'fair' market rates, i.e. that do not constitute a transfer in net present value terms, will therefore not increase financial intermediation. We assumed that the commitment problem of bankers requires that they obtain at least a fraction $(1-\phi)$ of their gross revenue. If government does not have a superior enforcement technology to relax this constraint, any repayments on emergency lending or dividend payments on public equity injections reduce the share obtained by bankers in precisely the same fashion as repaying bank depositors. Such repayment obligations therefore decrease the amount of deposits that bankers can obtain by an equal amount and do not expand capital intermediation.

Conversely, if government had superior enforcement capabilities to extract repayments or dividends, then those special capabilities would represent an additional reason for government intervention in the instrument(s) that relax the constraint most.

B.4 Bailouts Conditional on Individual Bank Capital

The adverse incentive effects of bailouts are aggravated if bailouts are conditional on individual bank capital e^i. Such bailouts provide bankers with an additional incentive to increase risk-taking in order to raise the expected bailout rents received.

To capture this notion, suppose that the bailout received by an individual banker i for a given level of individual and aggregate bank equity (e^i, e) is given by

$$t\left(e^i, e; \gamma\right) = \begin{cases} 0 & \text{if } e \geq \hat{e} \\ \hat{e} - (1-\gamma)\, e - \gamma e^i & \text{if } e < \hat{e} \end{cases}$$

where $\gamma \in [0, 1]$ captures the extent to which the bailout depends on individual bank equity. This specification nests our baseline model in which bailouts are entirely conditional on aggregate bank capital ($\gamma = 0$), but now also includes bailouts that are partially or wholly contingent on individual bank capital ($\gamma > 0$). Alternatively, if banks are non-atomistic and bailouts are conditional only on aggregate bank capital e, we can interpret the parameter γ as the market share of individual banks, since each bank will internalize that its bank equity makes up a fraction γ of aggregate bank equity.

We denote the amount of their endowment that bankers allocate to the risky project in period 0 by $x^{BL}(\gamma)$, and we find that bailouts have the following effects:

Proposition B2 (Risk-Taking Effects of Bailouts) *(i) Introducing bailout transfers increases period 0 risk-taking $x^{BL}(\gamma) > x^{LF}$ for any $\gamma \geq 0$.*

(ii) Risk-taking $x^{BL}(\gamma)$ is an increasing function of γ.

Proof. Since we proved in Proposition 9 that $x^{BL}(\gamma) > x^{LF}$ holds for $\gamma = 0$, (ii) implies (i). To prove (ii), observe that the welfare maximization problem of bankers under bailouts for a given parameter γ is

$$\max_{x^i \in [0,1], e^i} \Pi^{BL}\left(x^i, x; \gamma\right) = E\left[\pi^{BL}\left(e^i + t\left(e^i, e; \gamma\right), e + t\left(e\right)\right)\right]$$

where $e^i = 1 - x^i + \tilde{A}x^i = e$ in equilibrium. Let us define $\hat{A}$ as the level of $\tilde{A}$ that achieves the bailout threshold $\hat{e}$. The optimal choice of $x^{BL}(\gamma)$ satisfies

$$\Pi_1^{BL}\left(x^{BL}, x^{BL}; \gamma\right) = (1-\gamma)\pi_1(\hat{e}, \hat{e}) \int_0^{\hat{A}} (\tilde{A} - 1) dG(\tilde{A}) + \int_{\hat{A}}^{\infty} (\tilde{A} - 1)\pi_1 dG(\tilde{A}) = 0$$

Differentiating the optimality condition at x^{BL} for a given γ yields

$$\frac{d\Pi_1^{BL}}{d\gamma} = -\pi_1(\hat{e}, \hat{e}) \int_0^{\hat{A}} (\tilde{A} - 1) dG(\tilde{A}) > 0$$

where the inequality holds since we assumed $\hat{A} < 1$. ■

Point (ii) captures that the risk-taking incentives of bankers rise further because they internalize that one more dollar in losses will increase their bailout by γ dollars. This captures the standard notion of moral hazard, i.e. that bailouts targeted at individual losses increase risk-taking.

Redistributive Effects Corollary 10 showed that Bankers benefit by the introduction of bailouts, while workers benefit from the market-completion effect and are hurt by the incentive effect of bailouts. Since the market-completion effect does not depend on γ, higher γ acts as a pure incentive effect that raises risk-taking, and benefits bankers at the expense of workers. Therefore $\gamma > 0$ exacerbates the distributive effects of bailouts.

C Data Sources

Data for Figure 1

Unless otherwise noted, data is taken from the Federal Reserve Bank of St. Louis FRED database (Federal Reserve Economic Data).

Panel 1: Bank equity is calculated as the difference between the series "Total Liabilities and Equity" and "Total Liabilities" in the "Financial Business" category, from the Federal Reserve Flow of Funds data (series FL - 79 - 41900 and 41940). The market value of equity is used since book values do not reflect the losses incurred during the financial crisis in real time. The resulting series is deflated by "Gross Domestic Product: Implicit Price Deflator" (FRED series GDPDEF).

Panel 2: The spread on risky borrowing in Panel 4 is the difference between "Moody's Seasoned Baa Corporate Bond Yield" (FRED series BAA) and "10-Year Treasury Constant Maturity Rate" (FRED series DGS10).

Panel 3: The real wage bill is "Compensation of employees, received" (FRED series W209RC1) deflated by "Gross Domestic Product: Implicit Price Deflator" (FRED series GDPDEF).