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Democratic Political Economy of Financial Regulation

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Abstract

This paper offers a simple theory of inefficiently lax financial regulation arising as an outcome of a democratic political process. Lax financial regulation encourages some banks to issue risky residential mortgages. In the event of an adverse aggregate housing shock, these banks fail. When banks do not fully internalize the losses from such failure (due to limited liability), they offer mortgages at less than actuarially fair interest rates. This opens the door to home ownership for young, low net-worth individuals. In turn, the additional demand from these new home-buyers drives up house prices. This leads to a non-trivial distribution of gains and losses from lax regulation among households. On the one hand, renters and individuals with large non-housing wealth suffer from the fragility of the banking system. On the other hand, some young, low net-worth households are able to get a mortgage and buy a house, and current (old) home-owners benefit from the increase in the price of their houses. When these latter two groups, who benefit from the lax regulation, constitute a majority of the voting population, then regulatory failure can be an outcome of the democratic political process.

Topics: Financial stability, Financial system regulation and policies, Housing, Interest rates
JEL codes: E43, E44, G01, G21, G28, P48

1 Introduction

Many have argued that the "bubble" in the housing market, whose burst led to the 2008 financial crisis, was fueled by "irresponsible" lending practices of mortgage lenders (e.g., Acharya et al. (2011), Brunnermeier (2009), Dell'Ariccia, Igan, and Laeven (2012), and Mian and Sufi (2009)). This excessive risk-taking by lenders (banks) was permitted by the regulatory environment of the early 2000s (see, for example, Bernanke (2010) and Zingales (2008)). In this paper, we point out that democratic political process may lead to inefficiently lax banking regulation, which results in loose lending standards on mortgage loans and inflates a house-price "bubble." This occurs when the beneficiaries of such policy — existing homeowners, who benefit from the increased house prices, and wealth-poor home-buyers, who benefit from lower mortgage interest rates — outnumber its opponents — wealthy buyers and renters, who are exposed to the fragility of the financial system.

The economic mechanism underlying the political considerations is an intuitive one. Loose financial regulation permits some banks to adopt a "gambling" strategy of specializing in *risky* residential mortgages. In the event of an adverse aggregate housing shock, these banks fail. Since these banks do not fully internalize the losses from such failure (due to limited liability), they offer mortgages at less than actuarially fair interest rates. This opens a door to homeownership for some young individuals with low net-worth. In turn, the additional demand from these new home-buyers drives up house prices. All of this leads to non-trivial distribution of gains and losses among households from lax regulation. On the one hand, renters and individuals with large non-housing wealth suffer from the fragility of the banking system induced by the lax regulation. On the other hand, some middle-income young households are able to get a mortgage and buy a house, thus benefiting from the lax regulation. Furthermore, the current (old) homeowners benefit from the increase in the price of their houses. If the latter two groups constitute a majority of the population, then regulatory failure can be an outcome of a democratic political process.

To capture this key mechanism, we present a parsimonious two-period model populated by overlapping generations of heterogeneous households. In the first period, initial old people are endowed with houses, while initial young are endowed with heterogeneous wealth. The young derive utility from owning a house and are thus interested in buying a house from the initial old or from the newly constructed stock. Construction technology is subject to decreasing returns to scale. Young households can finance a house purchase using their initial wealth and by taking on defaultable non-recourse mortgages from banks (or foreign investors). We abstract from idiosyncratic uncertainty, so the only source of mortgage defaults in the second period is a possible adverse realization of an aggregate house-value shock. Thus, mortgage portfolios are subject to aggregate risk. Limited liability on the side of the bankers generates a moral hazard — banks may be willing to issue risky mortgages at below actuarially fair interest rates, since the bankers do not (fully) internalize the losses in the event of the adverse housing shock. We abstract from the obvious misallocation of risk generated by such bank behavior by ignoring the risk-aversion of domestic depositors. We focus instead on the (mis)-allocation of investment. If banks lower their lending standards (i.e., issue mortgages at excessively low interest rates), the inflow of new borrowers (home-buyers) leads to higher home prices and (possibly inefficient) construction boom. Thus, even in the absence of risk-aversion, the model yields a meaningful moral hazard in banking, which needs prudential regulation to address it.[1] Prudential regulation in the model takes the form of a risk-weighted capital requirement.[2] We will refer to the level of regulation that achieves efficient allocation (i.e., solution to the social planner's problem) as the efficient regulation.

The key finding of the paper is that the efficient level of regulation is likely *not* to be an outcome of a democratic process, and that a lax regulation is likely to be adopted instead. We offer sufficient conditions under which laissez-faire equilibrium is preferred to the one under efficient regulation by a *majority* of agents in the economy. This majority is composed of two distinct groups — low-wealth young buyers, who benefit from resulting lax lending standards and are thus able to finance purchasing a home, and old homeowners, who benefit from the increased house prices bid up by the additional buyers.

While this key finding is rather intuitive, it is worth noting that it demands some key ingredients from the model. For example, we would not get our main result without a decreasing returns-to-scale construction industry. If the stock of houses is fixed, then the only beneficiaries of lax regulation are the old homeowners, as the house price increase in equilibrium of that model absorbs all of the gains from lax lending standards and the pool of equilibrium home-buyers remains unchanged. Linear construction technology, in contrast, would preclude house prices from rising in response to lax banking regulation, thus eliminating any gains from lax regulation to the old homeowners and concentrating the benefits from such regulation to poorer young home-buyers only. Our model is thus a minimal environment needed to generate the *coalition* of young (poor home-buyers) and old (home-sellers) that favors lax regulation.

Our model further highlights the importance of wealth inequality for the analysis of the effects of financial regulation and the distribution of welfare benefits of any such regulation.[3] The implications of (an increase in) inequality are surprisingly rich. On the one hand, an increase in wealth inequality may lead to a larger share of prospective "subprime" borrowers, who can afford a house only under a lax regulation and thus support deregulation (the mechanism pointed out by Rajan (2010) and Calomiris and Haber (2014)). On the other hand, if an increase in inequality yields more young people who have

[1]Another potentially important consideration we are abstracting from is the dead-weight loss of a bank failure. Thus, (preventing) the misallocation of investment is the sole reason for banking regulation in our model.

[2]Of course, this simple form of regulation is meant as a stand-in for all manner of possible banking regulation, including branching restrictions in the US emphasized in Favara and Imbs (2015), as well as facilitation of securitization and implicit guarantees offered by Government Sponsored Enterprises, highlighted by Jeske, Krueger, and Mitman (2013).

[3]Given the stark nature of our almost single-period model, we do not make a distinction between income and wealth heterogeneity.

no hope of ever buying a house, then that leads to an increase in support for strict financial regulation, which protects renters' meager savings. We thus emphasize the importance of the "middle" of the wealth distribution rather than the concentration of wealth at the top, which typically steals the spotlight.

We should also point out that the marginal ("subprime") home-buyers are not the only young households benefiting from an inefficiently lax regulation. Infra-marginal ("prime") borrowers also take advantage of the low mortgage interest rates induced by deregulation. In our model, deregulation yields not only an extension of more subprime mortgages, but also increased mortgage debt in the prime segment, consistent with the key point of Adelino, Schoar, and Severino (2016), Foote, Loewenstein, and Willen (2020), and Albanesi, De Giorgi, and Nosal (2017).

This research contributes to the growing literature on the political economy of the mortgage crisis and the housing boom that preceded it. Key early papers in this literature (Mian, Sufi, and Trebbi (2010), Mian, Sufi, and Trebbi (2013), Igan, Mishra, and Tressel (2012)) were empirical and focused primarily on the effects of lobbying by financial institutions (though often taking into account constituents' preferences as well).[4] We instead abstract from the political involvement of financial firms and focus on formalizing a specific economic mechanism in a democratic political setting and on characterizing explicitly which voters stood to gain from lax regulation. The paper closest in spirit to ours is Sheedy (2018), which shows that popular political pressure may lead to excessively loose monetary policy, inflating an asset price bubble and making the economy susceptible to financial crises. Two key distinctions between our papers are the policy in question (prudential versus monetary) and the nature of household heterogeneity (wealth inequality versus solely generational differences).[5] Due to lack of wealth heterogeneity in Sheedy (2018) and the resulting lack of the extensive margin of homeownership, all young and middle-aged voters vote as one in that model, and the nature of the political conflict is purely intergenerational. In contrast, we emphasize the importance of wealth heterogeneity among young prospective home-buyers and the political tension within a cohort between different parts of that wealth distribution.[6] Jeske, Krueger, and Mitman (2013) do incorporate wealth inequality in the model and explicitly identify winners and losers from an alternative policy (an implicit mortgage subsidy), but their analysis lacks the house price channel, which we argue is critically important, and they do not explicitly consider the political economy behind the policy choice.[7] It is worth pointing out that this critical house price channel and the tension

[4]A notable exception is Bolton and Rosenthal (2002), who theoretically analyze not only ex-post but also ex-ante implications of political intervention in debt enforcement.

[5]Tressel and Verdier (2014) also focus on the politics behind prudential regulation, but the political tension they focus on is that between bankers, entrepreneurs, and (uninformed) investors. In contrast, our analysis and that of Sheedy (2018) focus on the distribution of gains and losses among households and do not give banks a voice in the democratic process.

[6]As we discuss in detail in Section 5.3, this tension often generates the "ends-against-the-middle" feature, familiar from the literature on public education in the presence of private option (Barzel (1973); Epple and Romano (1996a,b); Fernandez and Rogerson (1995)).

[7]Kiyotaki, Michaelides, and Nikolov (2011) also explicitly analyze winners and losers, but from an exogenous change in

between homeowners and renters are also present in the analysis of the political economy of local building restrictions (Ortalo-Magné and Prat (2014) and Parkhomenko (2018)). Our paper is also clearly related to the ample literature on regulatory failure (ranging from rational, as in Brusco and Castiglionesi (2007), to failures driven by time-inconsistency of policy makers, as in Chari and Kehoe (2008) for example, to failures arising from the policy maker's own moral hazard, as in D'Erasmo, Livshits, and Schoors (2019)). Unlike the latter, we abstract from the agency problem of the regulator, and focus instead on the possible *democratic* political roots of the regulatory failure.

The rest of the paper is organized as follows. Section 2 presents the model environment. Section 3 presents individual agents' problems and defines the economic equilibrium for a given set of policies (regulation). Section 4 characterizes two key benchmarks — laissez-faire equilibrium and socially efficient allocation — and analyzes the effects of financial regulation on economic equilibrium. Section 5 highlights the key finding of the paper and analyzes political economy aspects of the model. Section 6 discusses the robustness of our results to relaxing some of the simplifying assumptions of the model. Section 7 concludes. All proofs are relegated to Appendix B.

2 Environment

We formulate a parsimonious almost-static model built to highlight the key economic mechanism. The model economy lasts for two periods. In the first period, it is populated by measure H_O of old people who own houses, and measure 1 of young people, who live for two periods.[8] Besides these individuals, the economy has foreign investors, who live for two periods, and construction firms, who operate in the first period. All agents in the economy are risk-neutral. Besides houses, which do not depreciate, there is a single perishable consumption good per period.

2.1 Households

Individuals consume perishable goods when old, and derive utility u from homeownership. Young households receive idiosyncratic income $w \in \mathbb{R}_+$ (of perishable goods) in the beginning of the first period, which is drawn from continuous distribution $F(.)$.[9] We assume that F is strictly increasing over the support of the distribution (i.e., that there are no gaps in the distribution of wealth). We denote

the economic environment rather than policy.

[8]Initial old individuals who do not own a home do not interact with the rest of the economy and are thus left out of the model.

[9]This can be thought of as random endowment of efficiency units of labor, which is inelastically supplied to goods-producing and construction sectors.

the aggregate endowment of young households by $W := \int w dF(w)$. The endowment can be spent on purchasing a house or invested in a bank. Households have no other investment technology.

2.2 Banks and Foreign Investors

There is a continuum of foreign investors who can freely enter the domestic financial sector. These investors are risk-neutral and have access to the international capital market, where the risk-free rate of return is $\bar{r} = 0$. These investors may choose to open a bank in our economy, in which case they can accept deposits from domestic households, but they are then subject to any domestic banking regulation. Alternatively, they can invest (foreign) funds into the domestic mortgage market without opening a bank (we will refer to this as a "private equity" investor). Or they may choose to stay out of the domestic financial markets altogether.

2.3 Houses

There are H_O units of housing at the beginning of period 1. We will denote the measure of houses built in period 1 by I. Thus, the total measure of housing units traded in period 1 is $H = H_O + I$. We will assume $H_O \in [0, 1)$, so that the existing stock is not enough to accommodate all the young households. (This assumption makes sure that houses are not free in period 1.) Houses are subject to an aggregate valuation shock in the second period. (We are abstracting from idiosyncratic house-valuation shocks because only the aggregate shock is capable of affecting lenders with diversified mortgage portfolios.) The house value (price) is either high, v, with probability p, or low, 0, with probability $(1 - p)$.[10]

2.4 Construction

New houses are produced by measure 1 of competitive construction firms with identical decreasing returns-to-scale production functions. The firms are owned by old households.[11] The cost of producing I units of housing is $k(I)$, which is strictly increasing, strictly convex, and differentiable, and satisfies $k(0) = k'(0) = 0$.

2.5 Investments and Financial Markets

Banks can invest in two types of assets: safe projects with deterministic rate of return $\bar{r} = 0$, and mortgages, which are defaultable. We will denote bank j's investments in the safe assets by s_j, and investments in

[10] The latter is more than a normalization, as this implies zero recovery for the lenders in the event of a foreclosure.
[11] Alternatively, we can assume that the construction firms are foreign-owned.

mortgages by m_j. The bank's balance sheet can be put simply as $s_j + m_j = e_j + d_j$, where e_j is the bank's equity and d_j is the amount of deposits in bank j.

Mortgages are non-recourse, which immediately implies that they will be repaid in equilibrium only if the value of the house (weakly) exceeds the face value of the mortgage. All "underwater" mortgages are defaulted on. The mortgage interest rates reflect the implied risk of default.

2.6 Regulation

A regulatory authority can impose capital requirements on banks operating in the economy. (By "operating" we mean accepting deposits.) We assume that this capital requirement is risk-weighted, and that the regulator observes the asset allocation of a bank. A capital requirement prescribes that bank(er)s must own fraction $\alpha \in [0, 1]$ of the bank's (risky) investments in mortgages,

$$e_j \geq \alpha m_j, \tag{1}$$

where e_j is bank j's equity and m_j is the bank's mortgage investments. We are thus assuming that investments in safe assets have a risk weight of 0 in banking regulation.

3 Economic Equilibrium

This section spells out individual agents' problems and defines the economic equilibrium of the model for any given regulation. We first present the optimization problems faced by individual agents in the economy, taking net interest rates on deposits (i) and on mortgages (r), as well as house prices (q), as given. Recall that the net rate of return on safe assets has been normalized to 0. Households further take as given the fraction of deposits τ that are lost in the event of the adverse aggregate house-valuation shock. Since houses are worth 0 in the second period in the adverse aggregate state and mortgages are assumed to be non-recourse, all mortgages are necessarily risky. Rather than explicitly expressing the mortgage default decision, we save on notation by taking as given that mortgages are not repaid in the adverse aggregate state. We then define the economic equilibrium, which determines the market-clearing values of these prices for any given policy.

3.1 Banks' Problem

On the liability side, a banker (foreign investor who chooses to open a bank) selects the level of equity (capital) in the bank $e \in \mathbb{R}_+$ and the amount of deposits d it accepts. She then chooses how to allocate these funds between investments in the safe assets, s, and risky mortgage loans, m. Mortgage loans are risky in the sense that they are not paid back in the second period in the adverse aggregate state of houses being worthless, which occurs with probability $(1 - p)$.

The (foreign) investors' profit maximization problem is as follows.

Problem 1. *Taking interest rates r and i as given, an investor solves*

$$\max_{(d,e,m,s)\in\mathbb{R}^4_+} \Big((1-p)\max\left\{s-(1+i)d, 0\right\} + p\left[(1+r)m + s - (1+i)d\right] - e \Big)$$
$$\text{s.t.} \quad m + s = d + e,$$
$$\text{and} \quad e \geq \alpha m \quad \text{if} \quad d > 0.$$

Since the investor's problem is linear, any competitive equilibrium has to yield zero expected profits in the financial sector. For the same reason, we can restrict attention to equilibria where individual banks and investors completely specialize — they invest either only in mortgages or only in the safe asset.

Lemma 1. *For any equilibrium of our economy in which individual banks (and investors) purchase both mortgages and the safe asset, there is an outcome-equivalent equilibrium in which individual banks (investors) specialize.*

Thus, without loss of generality, we will focus on the case where banks specialize in holding a single type of asset. We will refer to banks holding only the safe asset as "safe banks," and we will refer to banks purchasing (risky) mortgages as "mortgage banks." Note that a "private equity investor" is basically just a mortgage bank that does not accept deposits (and thus is not subject to any banking regulation).

3.2 Young Households' Problem

Young households choose whether to buy a house (this binary decision is denoted by $h \in \{0, 1\}$), and how much mortgage to undertake to finance the purchase. Their problem is then simply

Problem 2. *Taking house price q, interest rates r and i, fraction of deposit at risk τ, and their own wealth* *w as given, households solve*

$$\max_{h\in\{0,1\},(d,m)\in\mathbb{R}_+^2} \left[uh + (1-p)c_L + pc_H\right]$$

$$\text{subject to } d + qh = w + m, \tag{2}$$

$$c_L = (1+i)(1-\tau)d, \tag{3}$$

$$c_H = (1+i)d + vh - (1+r)m,$$

$$(1+r)m \leq vh, \tag{4}$$

where v is the house price in the second period in the absence of the adverse aggregate housing shock.

Note that constraint (3) incorporates (partial) loss of deposits due to failure of mortgage banks, and that constraint (4) is the endogenous borrowing constraint in our environment.

Old households' problem is trivial — they simply consume proceeds from the sale of their houses and the profits of construction firms.

3.3 Construction Firms' Problem

The construction firm's problem is

Problem 3. *Taking house price q as given, a construction firm solves*

$$\max_{I\in\mathbb{R}_+} \left[qI - k(I)\right].$$

3.4 Equilibrium Definition

For any given regulation, the equilibrium in this economy is characterized by the house price q in the first period, interest rates i on deposits and r on mortgages, the measure I of houses constructed, and policy functions of bankers and households (functions of individual wealth), such that policy functions solve individuals' maximization problems and all markets clear. In formally defining the equilibrium, we will save on notation by calling on Lemma 1 to allow us to separate financial firms into "mortgage banks" with total deposits D_M and total assets M_M, "safe banks" with total deposits D_S, and "private equity investors" with assets M_P. This means that the fraction of deposits at risk is simply the fraction of households' deposits placed in the mortgage banks: $\tau = \frac{D_M}{D_M+D_S}$.

Definition 1. *A competitive equilibrium in this economy consists of prices (q, i, r), household policy functions $(h(w), m(w), d(w))$, housing output I of the representative construction firm, banking allocation (D_M, M_M, D_S, M_P), and share τ of household deposits held in "mortgage banks," such that*

1. *Households' policy functions solve their maximization Problem 2.*

2. *Investors' allocation solve their maximization Problem 1.*

3. *Construction firms' allocation solves their maximization Problem 3.*

4. *Markets clear:*

   (a) *Housing market clears:* $H_O + I = \int h(w)dF(w)$.

   (b) *Mortgage market clears:* $M_M + M_P = \int m(w)dF(w)$.

   (c) *Deposit market clears:* $\int d(w)dF(w) = D_M + D_S$.

We will denote the total deposits in the economy by $D = D_M + D_S$, the total mortgage debt by $M = M_M + M_P$, and the total housing stock by $H = H_O + I$.

4 Economic Outcomes

In this section we present the key economic insights from our model, which we then use as input into the political economy model. In order to do so, we begin by describing two key benchmarks — laissez-faire equilibrium and socially-efficient allocation — and then explicitly characterize the effects of financial regulation on equilibrium outcomes.

4.1 Preliminary Results

We begin by establishing a few basic points regarding the economic equilibria in this model before proceeding to establish the key results. The first two lemmata lay out key points regarding housing supply and demand, respectively. The next two lemmata expose key features of the financial sector in equilibrium. And the last two lemmata provide basic insights into the effects of banking regulation.

Lemma 2. *Since $H_O < 1$, there is strictly positive level of construction in equilibrium, and the equilibrium house price is equal to the marginal cost of building a house:*

$$q = k'(I) \tag{5}$$

Lemma 3. *Young households with wealth below $\underline{w}$ cannot afford to buy a house, where*

$$\underline{w} = q - \frac{v}{1+r}. \tag{6}$$

Note that the threshold $\underline{w}$ may be negative in equilibrium, in which case, every young household can afford to buy a house. The expression $q - \frac{v}{1+r}$ can be thought of as the "private user cost" of a house, and the lemma simply states that a young home-buyer has to be wealthy enough to afford that user cost.[12]

Lemma 4. *For any equilibrium of our economy, there is an outcome-equivalent equilibrium in which individual banks and investors specialize and banks (which accept deposits) hold just the minimal amount of equity required by the regulation.*

This lemma builds on Lemma 1 and allows us to separate mortgage banks, which hold minimal required equity, from private-equity investors issuing mortgages.

Lemma 5. *Bankers make zero expected profits in all activities operating in equilibrium and non-positive profits on activities that are not operating:*

1. *Expected rate return to the owners of a mortgage bank does not exceed $\bar{r} = 0$, and is equal to 0 if there are mortgage banks in equilibrium:*

$$p\big[(1+r) - (1+i)(1-\alpha)\big] - \alpha \leq 0, \qquad \textit{with equality if } D_M > 0 \tag{7}$$

2. *Expected return to the owners of a safe bank does not exceed $\bar{r} = 0$, and is equal to 0 if there are safe banks in equilibrium:*

$$i \geq 0, \qquad \textit{with equality if } D_S > 0 \tag{8}$$

3. *Expected return to investing own wealth does not exceed $\bar{r} = 0$, and is equal to 0 if there is any private-equity investment in mortgages in equilibrium:*

$$p(1+r) - 1 \leq 0, \qquad \textit{with equality if } M_P > 0 \tag{9}$$

Note that at most two types of investment firms (activities) are present in any equilibrium (i.e., $D_S D_M M_P = 0$ in equilibrium).

In what follows, it will be convenient to refer to the actuarially-fair interest rate on mortgages (from the foreign investors' perspective) as $r^* = \frac{1}{p} - 1$.

Lemma 6. *As long as $\alpha < 1$, the equilibrium features some mortgage banks ($D_M > 0$), there is strictly positive probability of bank failure ($\tau > 0$), and the mortgage interest rates satisfy $r = \alpha r^* + (1-\alpha)i$ with $i \in [0, r^*]$.*

[12]The *social* (marginal) "user cost" of an additional house is $k'(I) - pv$.

That means that the only way to preclude the possibility of bank failure is to prohibit channeling *any* of the households' deposits into mortgages by setting $\alpha = 1$. That extreme policy simply rules out what we call "mortgage banks," i.e., banks that accept deposits and invest in nothing but mortgages.

Lemma 7. *The extreme regulation $\alpha = 1$ shuts down mortgage banks ($D_M = 0$), prevents all bank failure ($\tau = 0$), and results in interest rates $i = 0$ and $r = r^*$ on deposits and mortgages, respectively.*

4.2 Laissez-Faire Equilibrium

Unregulated banking equilibrium necessarily features zero-equity mortgage banks, which simply funnel households' deposits into mortgages. The competition among these banks implies that the interest rate i promised on deposits is the same as the interest rate r charged on mortgages.

Lemma 8. *In any laissez-faire equilibrium (i.e., whenever $\alpha = 0$), mortgage banks are active but hold no equity ($M_M = D_M > 0$). Thus, $\tau > 0$ and $i = r$ in any laissez-faire equilibrium.*

Using this basic insight, we can characterize the banking equilibrium in the absence of financial regulation.

Proposition 1. *Laissez-faire banking equilibrium takes one of three possible forms:*

1. *Current-account surplus ($D > M$): Household deposits exceed mortgages in equilibrium and some of these deposits are placed in safe banks and invested in safe assets (abroad). In this equilibrium, $i = r = 0$ and $0 < \tau < 1$.*

2. *Current-account balance ($D = M$): Amount deposited by households is exactly equal to the amount of mortgages issued. Zero-equity mortgage banks are the only activity in the banking sector. Thus, $\tau = 1$, while $0 \leq i = r \leq r^*$.*

3. *Current-account deficit ($D < M$): Household deposits are insufficient to finance all of the mortgages. Some mortgages are issued by (foreign) investors who do not accept deposits. In this case, $i = r = r^*$ and $\tau = 1$.*

Current-account surplus equilibrium has both mortgage banks and safe banks operating (with households unable to tell them apart). Private-equity investors are inactive in this equilibrium. In contrast, current account deficit equilibrium has no safe banks, but the private-equity investors do issue mortgages. Lastly, neither safe banks nor private-equity investors find it worthwhile to operate in a current-account balance equilibrium.

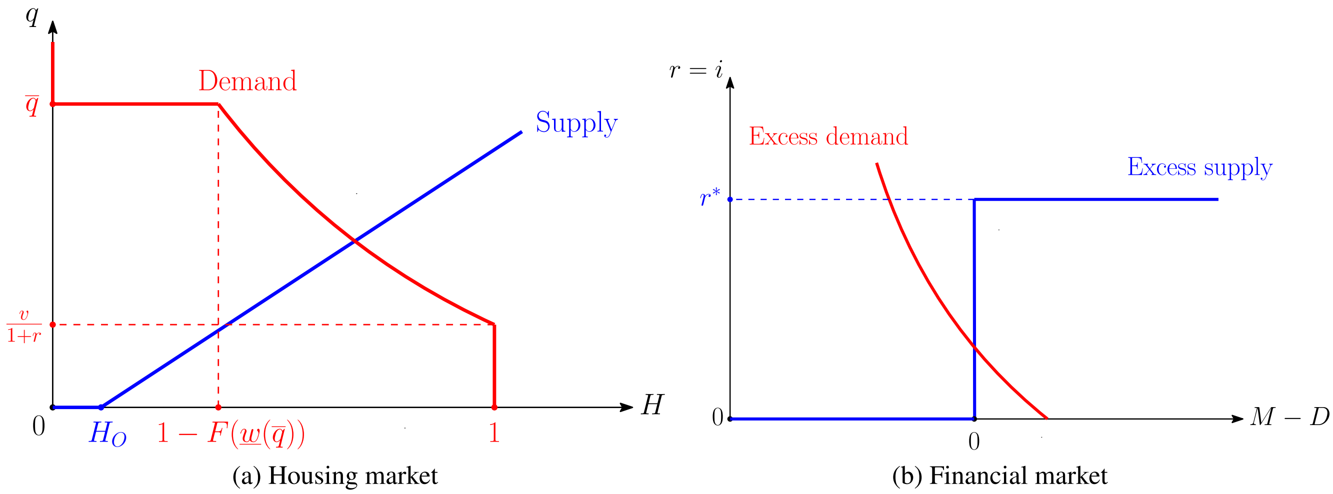

Figure 1: Laissez-Faire Equilibrium

We now turn to the determination of the level of interest rates in (and the type of) equilibrium, along with the house price. This economic equilibrium is pinned down by market clearing in housing and financial markets, which is illustrated in Figure 1.

In the housing market, the supply (beyond the H_O units supplied inelastically by the old) is driven entirely by the construction sector and is fully characterized in Lemma 2. Simply equating the house price q to the marginal cost of building a house $k'(I)$ yields the mapping $I^S(q)$ from the house price to the construction level:

$$k'\left(I^S(q)\right) = q.$$

We have thus characterized the level of housing supply as $H_O + I^S(q)$. The demand for houses is determined in large part by the ability of young households to afford a house, characterized in Lemma 3. The other key consideration is the maximum "willingness to pay" for a house, $\overline{q}$, which reflects the utility of ownership, the present value of the house's resale value next period, and the possible financial benefits of taking out a mortgage and of investing own wealth outside of the banking system:[13]

$$\overline{q} = \frac{1}{1+r}\left(\frac{u}{1-\tau(1-p)} + v\right). \tag{10}$$

As long as house price is strictly below the households' maximum willingness to pay $\overline{q}$, every young household who can afford a house buys one. Thus, the housing demand for $q < \overline{q}$ is given by $1 - F(\underline{w}(q))$, where $\underline{w}(q)$ is given by equation (6). Of course, the demand for houses cannot exceed 1, so the demand curve is vertical for prices below $\frac{v}{1+r}$ because every young household buys a house at those prices. At

[13]Please see Appendix A for a more detailed discussion and the derivation of this expression.

the other end, the demand curve is horizontal at $q = \overline{q}$ because young households are indifferent between buying a house at the price $\overline{q}$ and not buying a house.

While the housing supply is unaffected by interest rates, the housing demand curve shifts down whenever the mortgage interest rate r increases. An increase in r lowers both the households' willingness to pay for a house and their ability to afford one. Thus, a higher mortgage interest rate translates into a lower house price and a lower quantity of transactions in the housing market (thus lowering the demand for mortgages in the financial market).

The financial market is represented on the right panel of Figure 1, which incorporates the equilibrium condition $i = r$. The "excess demand" for mortgages (which we define as the difference between mortgage demand from the households M and their supply of deposits D) is driven primarily by the housing market equilibrium and the amount of housing purchases. As we have just argued, this equilibrium quantity of housing transactions is monotonically decreasing in interest rates. Thus, the excess demand for mortgages $M - D = qH - W$ is decreasing in the r (i.e., the demand curve is downward-sloping).[14] The "excess supply" of mortgages, which is the net position of the foreign investors (bankers), is 0 as long the interest rates are strictly between 0 and r^*. If interest rates fell below 0, the foreign investors would borrow infinite amounts from domestic households and invest the funds in safe foreign assets. If interests were above the actuarially-fair mortgage rate r^*, these investors would borrow abroad and offer to supply infinite amount of mortgages. Thus, the excess supply curve turns horizontal at $i = r = 0$ and $i = r = r^*$. This excess supply curve can be seen as an illustration of Proposition 1.

4.3 Efficient Allocation

In order to establish the benchmark for policy analysis, we characterize the efficient allocation. Our notion of efficiency amounts to maximizing the utilitarian social objective (the sum of households' utilities) subject to the resource constraint and the (foreign) investors' participation constraint. We formulate the social planner's problem as a choice of consumption, housing investment, and state-contingent asset position in period 1. These state-contingent securities are traded in the world financial market with risk-free interest rate $\overline{r} = 0$, and there prices simply reflect the probability of the respective (aggregate) states.

[14]The expression for $M - D$ can be obtained by simply aggregating the budget constraint (2) across all young households.

Problem 4. *The utilitarian social planner solves*

$$
\begin{aligned}
&\max_{I,C_O,A_L,A_H} \left[C_O + u(H_O + I) + (1-p)C_L + pC_H\right] \\
&\textit{subject to } C_O + (1-p)A_L + pA_H = W - k(I), \\
&\qquad\qquad C_L = A_L, \\
&\qquad\qquad C_H = v(H_O + I) + A_H, \\
&\qquad\qquad 1 - H_O \geq I \geq 0, \quad C_O \geq 0, \quad C_L \geq 0, \quad C_H \geq 0,
\end{aligned}
$$

where C_O is the consumption of the initial old households, A_L and A_H are the planner's holdings of state-contingent securities paying 1 in period 2 in the event that the house value is low or high, respectively, and the prices of these securities in period 1 are $(1-p)$ and p, respectively.

This social planner's problem is essentially an optimal housing investment problem with transferable utility (subject to non-negative consumption constraint).[15] This is well illustrated by simply plugging in the resource constraints of Problem 4 into the objective function, which yields:

$$\max_{I} \left[W - k(I) + (u + pv)(H_O + I)\right]. \tag{11}$$

The solution to this modified problem simply equates the marginal value of an extra house to the marginal cost of building one. More formally, define I^* to be the level of construction that equates the marginal cost to marginal benefit:

$$k'(I^*) = u + pv. \tag{12}$$

This level of construction is the solution to the social planner's problem, unless the economy simply does not need that many houses or cannot afford it even after pledging the future (resale) value of the house along with the non-housing wealth (i.e., after setting all of the non-housing consumption to 0). We formalize these notions of need and affordability with the following assumptions:

Assumption 1. *There are enough young households to absorb the level of construction I^*, along with the stock of existing houses. That is, $1 - H_O \geq I^*$.*

Assumption 2. *The total resources that the social planner can pledge are sufficient to finance the efficient level of construction I^*. That is, $W + pv(H_O + I^*) \geq k(I^*)$.*

Proposition 2. *Under Assumptions 1 and 2, the socially optimal level of construction is I^*, defined in* (12).

[15]The linearity of the social objective function implies that the problem above remains essentially the same when the planner puts lower (or no) weight on the consumption of the initial old households.

If Assumption 2 is violated, the solution to the social planner's problem is simply to set all non-housing consumption to 0 and to build as many houses as the economy can afford (given by $W + pv(H_O + I) = k(I)$). We think that Assumption 2 is a very mild one and will impose it for the rest of the paper.

Note that neither the laissez-faire allocation nor the one obtained under the most restrictive regulation ($\alpha = 1$) is necessarily efficient. The regulated allocation may have an inefficiently low level of construction (and, thus, of homeownership). This inefficiency arises from the inability of poorer young households to afford a house and the lack of redistribution of wealth in the decentralized economy, and is exacerbated by the indivisibility of the housing units. In contrast, the laissez-faire allocation may result in *over*-construction due to the moral hazard in banking that we are emphasizing. Low mortgage interest rates (lower than actuarially-fair rate r^*) can offer a path to homeownership to too many young households, leading to an inefficient boom in house prices and construction. Note however that this housing boom need not be inefficient in general, as it may be undoing the inefficiently low level of construction in the fully regulated equilibrium.

The basic insight of Proposition 2 extends to the more general notion of efficiency, that of Pareto efficiency. More specifically, excess construction cannot be part of a Pareto optimal allocation.

Proposition 3. *No allocation with $I > I^*$ is Pareto efficient.*

To see that, consider the following improvement on the excess-construction allocation: Reduce construction by one house (thus saving $k'(I)$ units of good in the first period) and invest the savings into v units of the state-contingent asset paying in the high aggregate state (the price of which is p) and the remaining $(k'(I) - pv)$ into the risk-free asset. The former investment exactly compensates for the loss of resale value of the extra house, while the latter more than compensates any individual for the loss of utility of homeownership, since in the excess-construction allocation $k'(I) - pv > k'(I^*) - pv = u$. Non-negativity of consumption constraints prevents us from making a similar argument for improving over some allocations with $I < I^*$. Yet, the key messages that I^* is the natural efficiency benchmark and that over-construction (building more than I^*) is not efficient extend from the simple utilitarian objective to the wider notion of Pareto efficiency.

4.4 Inefficiency of Laissez-Faire Equilibrium

We can now turn to the question of whether the laissez-faire equilibrium allocation is efficient, or whether there is room for a financial regulation to improve efficiency. The condition for efficiency of an equilibrium allocation is very natural and intuitive. Recall that the equilibrium house price is always equal to the marginal cost of building a house, $q = k'(I)$, under any financial regulation. Proposition 2 thus implies that the equilibrium level of construction is inefficiently high whenever the equilibrium house price q

exceeds what we will call the fundamental value of the house, $u + pv$. We will call such an equilibrium a housing bubble. In the remainder of this subsection, we offer sufficient conditions for such a housing bubble to occur. That is, we present conditions under which financial regulation that restricts mortgages (thus limiting construction in equilibrium) can improve efficiency (and aggregate welfare).

For ease of analysis, we restrict attention to economies where the laissez-faire equilibrium is a current-account surplus (and as we will establish later, so are equilibria under financial regulation).[16] An easy way to guarantee the current-account surplus is to make sure that the total wealth (supply of deposits) in the economy exceeds the largest possible demand for mortgages.

Assumption 3. *The aggregate wealth of young households is large enough to exceed the largest possible demand for mortgages. That is,* $W > \frac{u}{p} + v$.

Note that Assumption 3 immediately implies Assumption 2.

Lemma 9. *Under Assumption 3, the laissez-faire equilibrium is current-account surplus and the equilibrium interest rates are* $i = r = 0$.

Assumption 3 thus implies that the mortgage interest rate in laissez-faire equilibrium does not reflect the risk of default. This immediately implies that young households are willing to pay more for a house than its fundamental value (equation (10) guarantees that $\overline{q} > u + pv$). However, in order to make sure that the equilibrium price of a house exceeds the fundamental value, we need to make sure that enough of these young households can afford to buy a house. Thus, the second condition needed to guarantee excess construction in equilibrium concerns the *distribution* of the wealth of young households.

Condition 1. $\quad F\big(u - (1-p)v\big) < 1 - H_O - I^*.$

Note that I^*, given by equation (12), is uniquely pinned down by model parameters. The condition requires simply that the demand for houses exceeds the supply when the price is equal to the fundamental value. Given that mortgage interest rate $r = 0$, the housing demand at $q = u + pv$ is $1 - F(\underline{w}(u + pv)) = 1 - F(u - (1-p)v))$. The housing supply at that price is $H_O + I^*$.

We are now ready to state the sufficient conditions for an inefficient housing bubble:

Proposition 4. *If Assumption 3 and Condition 1 are satisfied, then the laissez-faire equilibrium allocation is inefficient — equilibrium amount of housing construction exceeds the efficient level.*

[16]As we show later, financial regulation leads to an increase in mortgage interest rate in current-account surplus economies, thus suppressing housing demand. In economies where laissez-faire equilibrium is a current-account deficit or a current-account balance, imposing financial regulation may actually *lower* the mortgage interest rate. This counter-intuitive force implies that effects of financial regulation on overall mortgage demand, house price, and equilibrium level of construction are ambiguous when the economy does not start out in a current-account surplus.

In such laissez-faire equilibrium, lax lending standards (mortgage interest rates that do not fully reflect the risk of default) lead to inefficiently high levels of housing construction, as too many young households buy a house. Thus, imposing restrictions in the mortgage market is efficiency-improving. With this in mind, we now turn to financial regulation.

4.5 Effects of Banking Regulation

By forcing banks to back mortgage investments with equity, financial regulation can limit the mispricing of mortgage debt that underlies the inefficient housing boom described in the previous subsection. It is worth reiterating that since everyone in our economy is risk-neutral and there is no dead-weight loss associated with bank failure, the role of banking regulation in our model is quite distinct from the usual prudential concern. The welfare (efficiency) impact of the policy is driven by housing market outcomes, and not by changes in the probability or severity of bank failures. In this subsection, we characterize the effects of banking regulation on economic equilibrium outcomes and point out the winners and losers from such regulation.

Speaking of winners and losers, we choose to focus on the environment where young people strictly prefer buying a house to not buying one, i.e., where access to the mortgage market is strictly beneficial. As we show later, this implies that young households always prefer regulation that allows them to buy a house to one that precludes them from being able to afford it. A sufficient condition for that is:

Assumption 4. $F(u) > 1 - H_O - I^*$.

This assumption on the distribution of wealth among the young ensures that the equilibrium house price is "interior" (see Figure 1).

Proposition 5. *If Assumptions 3 and 4 hold, then* $q < \overline{q}$ *for all* α.

Under Assumption 3, increasing the capital requirement α leads to higher equilibrium mortgage interest rate r (as we establish in Lemma 10 below), and thus lowers the house price q and the level of construction I (see Proposition 6). The regulation also lowers the share τ of deposits in risky banks. As a result, banking regulation benefits two groups of young households: renters, who benefit from higher expected return on their deposits, and wealthy home-buyers, who benefit in addition from the lower house price. In contrast, less wealthy home-buyers suffer from the decrease in "mortgage subsidy" and some lose the ability to purchase a house altogether. Of course, initial old homeowners suffer from the decrease in the price they receive for their houses.

To formalize these arguments, we begin with establishing some basic economic effects of the banking regulation.

Lemma 10. *Under Assumption 3, the equilibrium is current-account surplus and the equilibrium interest rates are* $i = 0$ *and* $r = \alpha r^*$.

This result comes directly from Lemma 9 and the (mortgage) bankers' problem. The following result is of a more technical nature and allows us to simplify the exposition:

Lemma 11. *Under Assumption 3, for any equilibrium of our economy in which households take out mortgages of various sizes, there is an outcome-equivalent equilibrium in which all home-buyers take out the largest possible mortgage* $\left(m = \frac{v}{1+r}\right)$.

Moreover, this maximum leverage equilibrium is the only possible equilibrium under Assumption 3 whenever $\alpha < 1$. This result is quite intuitive — the expected interest rate that households receive on their deposits exceeds the expected interest rate they pay on their mortgages, whenever equilibrium is a current-account surplus. This is particularly easy to see in the laissez-faire case, where the promised interest rates on both deposits and mortgages are at 0, but while the mortgages are repaid only in the good aggregate state, the deposits yield partial repayment (a fraction $(1 - \tau) = 1 - M/D$) even in the adverse state. Hence, we will simply characterize the maximum leverage equilibrium in the rest of the section.

The best way to illustrate why the house price is decreasing in regulation is to turn to the left panel of Figure 1 and to note that, while the supply of housing is unaffected by banking regulation, the demand curve shifts down when regulation tightens (α increases). We apply Assumption 4 to make sure that the equilibrium is an "interior" one (i.e., $q < \overline{q}$), which implies that the demand for houses is simply $1 - F(\underline{w}) = 1 - F\left(q - \frac{v}{1+r}\right)$. And since interest rate r is increasing in α, the regulation decreases the demand for houses by increasing the threshold wealth level $\underline{w}$ needed to afford a house. We formalize all of this in the following proposition:

Proposition 6. *Under Assumptions 3 and 4, the equilibrium house price q and the level of construction I are decreasing in banking regulation parameter α, the fraction of deposits at risk τ is strictly decreasing in α, and the threshold wealth level for house affordability $\underline{w}$ is strictly increasing in α.*

One immediate corollary of Proposition 6, which is important for establishing (the distribution of) benefits of regulation, is the observation that the expected rate of return on deposits is increasing in the tightness of regulation α.

The lower level of construction due to regulation need not be an efficiency improvement in general, as the laissez-faire level of construction may be inefficiently low. But if Condition 1 is satisfied, then some degree of financial regulation is efficiency-improving. In contrast, under Assumption 4, maximum regulation leads to under-provision of houses (relative to the utilitarian social optimum).

Proposition 7. *If Assumptions 3 and 4 hold, then the equilibrium with maximum regulation ($\alpha = 1$) has an inefficiently low level of construction.*

Notably though, the basic political-economy mechanism (i.e., the distribution of winners and losers from financial regulation) is the same, regardless of whether the regulation is efficiency-enhancing or not. For example, the initial old homeowners prefer higher house prices, regardless of whether that price exceeds the fundamental value of the house or not. We turn to a more detailed discussion of gains and losses from financial regulation in the next section.

5 Political Economy

The key question of this paper is what gives rise to insufficient financial regulation, which in turn leads to inefficient housing boom. In order to answer that question, we begin by identifying who benefits from the lax regulation. We then offer sufficient conditions for the complete lack of regulation to defeat the socially efficient level of regulation in a simple majority vote.

5.1 Winners and Losers

Under the assumptions of our model, lax banking regulation, which leads to looser lending standards, benefits two groups of households — relatively poor young home-buyers, who benefit from depressed mortgage interest rates (including the marginal home-buyers, who would not be able to finance a house under tight lending standards), and old home-sellers, who enjoy the higher house prices induced by the additional housing demand. These observations follow directly from Proposition 6, which guarantees that both the house price and the fraction of young households buying a house are higher under a lax regulation. There are also two groups that are harmed by the lax regulation — wealth-poor renters, who receive lower expected return on their deposits, and relatively wealthy home-buyers, for whom losses from the lower expected return on deposits outweigh the gains from the mispriced mortgages.[17]

In order to formalize these statements in Proposition 8, it is helpful to define some conceptual notation. First of all, we will make explicit that equilibrium values of variables are dependent on the chosen policy level. For example, we will use $\underline{w}(\alpha)$ to refer to the wealth level of a marginal home-buyer when the banking regulation parameter is set at α. Note that Proposition 6 implies that, under Assumptions 3 and 4, $q(\alpha)$, $I(\alpha)$, and $\tau(\alpha)$ are decreasing in α, while $\underline{w}(\alpha)$ and $r(\alpha)$ are increasing in α. It will be convenient to define the expected rate of return on deposits $\tilde{i}(\alpha)$. Since the promised interest rate $i = 0$ in equilibrium (under Assumption 3), the expected realized rate is $1 + \tilde{i}(\alpha) = 1 - (1 - p)\tau(\alpha)$,

[17] By assuming that households are risk-neutral, we are abstracting from the additional cost of the deposits becoming risky under lax banking regulation. But the key insights carry over to a more general environment with risk-averse households. Old homeowners and marginal home-buyers still prefer loose regulation, while renters-depositors and wealthy home-buyers suffer even more from the lack of regulation, as their deposits become more risky.

which is increasing in α. We will additionally define $U(w;\alpha)$ — the expected utility level of a young household with wealth w obtained in equilibrium with regulation parameter α. In any maximum-leverage equilibrium, the expression for this indirect utility is simply

$$U(w;\alpha) = \begin{cases} w(1+\tilde{i}(\alpha)), & \text{for } w < \underline{w}(\alpha), \\ u + (w - \underline{w}(\alpha))(1+\tilde{i}(\alpha)), & \text{for } w \geq \underline{w}(\alpha). \end{cases} \tag{13}$$

This mapping, unlike the other policy-to-equilibrium mappings, need not be monotone in α. Young households at the bottom of the wealth distribution benefit from tighter regulation as it increases the expected rate of return $\tilde{i}(\alpha)$ on their savings. The same goes for the richest young households, with w high enough that the improvements in the expected return on deposits outweigh the decline in mortgage subsidy reflected in equation (13) by an increased value of $\underline{w}(\alpha)$. But things are a lot more complicated, and interesting, in the middle of the wealth distribution.

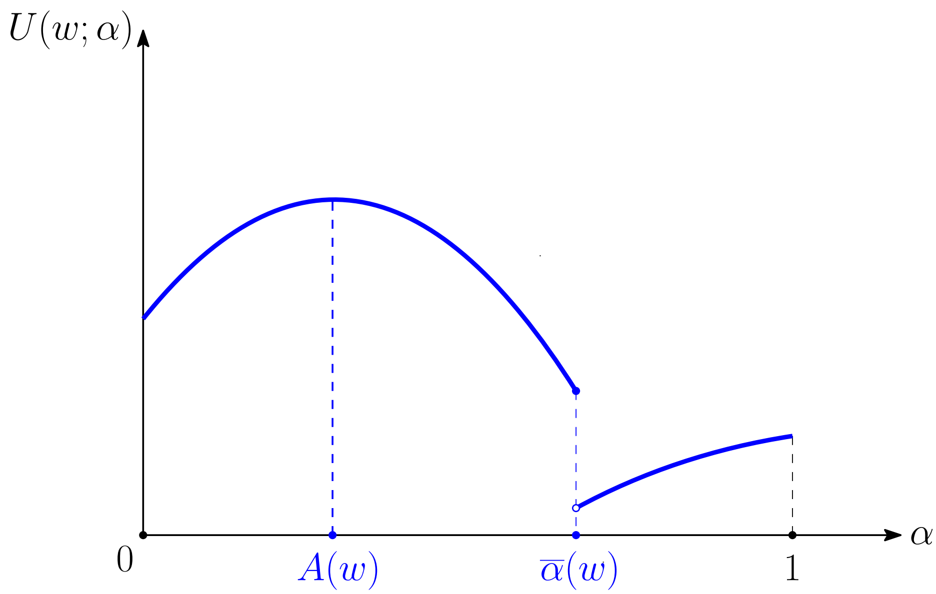

Figure 2: Indirect Utility

We illustrate this relationship between the level of regulation and the indirect utility of a middle-wealth young household in Figure 2. Consider a young household with wealth w such that the household is able to buy a house under lax regulation, but unable to do so under tight regulation. That is, there exists an interior level of regulation $\alpha \in (0,1)$ such that $w = \underline{w}(\alpha)$. In Figure 2, we denote this level of regulation, at which the young household with wealth w is penniless after buying a house, by $\overline{\alpha}(w)$. Since this young household is unable to purchase a house when regulation is tighter than $\overline{\alpha}(w)$, their indirect utility is increasing in α for $\alpha > \overline{\alpha}(w)$, as we have already established that renters-depositors benefit from tighter regulation. But critically, the indirect utility of this young household is discontinuous at $\overline{\alpha}(w)$. Under Assumption 4, households strictly prefer buying a house to renting, and being excluded from the mortgage market (which is what happens when α exceeds $\overline{\alpha}(w)$) is harmful to the household's utility. This point is formalized in Corollary 1 below. The shape of the indirect utility is harder to pin down to the left of $\overline{\alpha}(w)$. As can be seen from the second item of equation (13), the indirect utility is decreasing just to the left of $\overline{\alpha}(w)$. Locally, tighter regulation reduces the mortgage advance more than it reduces the price of the house, thus leaving the young household with lower savings. As we move away from the threshold $\overline{\alpha}(w)$ towards zero regulation, the rate of return on these savings becomes more important and marginal tightening of the regulation may actually be utility-improving for the household. We denote the level of regulation that yields that highest utility to a young household with wealth w by $A(w)$:

$$A(w) := \underset{\alpha \in [0,1]}{\operatorname{argmax}} \, U(w; \alpha). \tag{14}$$

The following proposition summarizes the set of winners and losers from regulation:

Proposition 8. *Consider two levels of banking regulation α and α', where $\alpha' > \alpha$. Then, under Assumptions 3 and 4,*

$$U(w;\alpha') - U(w;\alpha) \begin{cases} > 0, & \text{for } w < \underline{w}(\alpha), \\ < 0, & \text{for } w \in \left[\underline{w}(\alpha), \overline{w}(\alpha, \alpha')\right), \\ = 0, & \text{for } w = \overline{w}(\alpha, \alpha'), \\ > 0, & \text{for } w > \overline{w}(\alpha, \alpha'), \end{cases}$$

where

$$\overline{w}(\alpha, \alpha') = \frac{\underline{w}(\alpha')(1 + \tilde{i}(\alpha')) - \underline{w}(\alpha)(1 + \tilde{i}(\alpha))}{\tilde{i}(\alpha') - \tilde{i}(\alpha)} \tag{15}$$

is the wealth level of the young house-buyer indifferent between the two policy.

As we have already discussed, the poorest young households, who cannot afford a house even under the lax regulation α, prefer the stricter banking regulation. Marginal ("new") home-buyers and home-buyers with few deposits in the banking system prefer the lax regulation, as they benefit from the implied favorable interest rates on the mortgage. For home-buyers with wealth $w \in \left[\underline{w}(\alpha), \overline{w}(\alpha, \alpha')\right)$, the decline in the mortgage interest rate coming from the lax regulation is more than sufficient to offset the increase in the price of a house and the decline in expected rate of return on deposits. The cut-off wealth $\overline{w}(\alpha, \alpha')$ identifies the young household who have just enough deposits in the banking system that the impact on the expected deposit rate and the house price cancels out the decline in the interest rate on their mortgage, making them indifferent between the two levels of regulation. Note that $\overline{w}(\alpha, \alpha') > \underline{w}(\alpha') > \underline{w}(\alpha)$, which means that not only "new" home-buyers prefer lax regulation, but also some relatively wealth-poor households who are able to buy a house under either regulation.

An important corollary of Proposition 8 is that a young household who can afford a house under some policy α would never prefer a policy that excludes them from buying a house.

Corollary 1. *Under Assumptions 3 and 4, if there exists α such that $w \geq \underline{w}(\alpha)$, then $w \geq \underline{w}(\alpha')$ for any $\alpha' \in A(w)$.*

5.2 Political Failure

We have established that there are two groups of voters who favor lax regulation — initial-old home-sellers, who benefit from higher house prices, and marginal home-buyers, who benefit from lax lending standards (and low mortgage interest rates). We now offer a set of sufficient conditions (on parameters of our model) for what we call "political failure" — the situation when socially efficient financial regulation is defeated in a simple majority vote by a complete lack of regulation (leading to an inefficient housing bubble).

The purpose of this exercise is to establish that this dramatic regulatory failure is possible in equilibrium, rather than to point out when it is likely to happen. With that in mind, we opt for strong, but easy to interpret, conditions and do not attempt to make them as general as possible. In particular, we maintain Assumptions 3 and 4, as well as Condition 1 (which implies Assumption 1). Note that Condition 1 implies that $q(0) > u + pv$, i.e., the laissez-faire house price exceeds the fundamental value of the house. In contrast, Assumption 4 implies that the house price under the maximum regulation is below the fundamental value: $q(1) < u + pv$. Therefore, there exists an intermediate level of regulation $\alpha^* \in (0, 1)$, which delivers the socially efficient outcome, i.e., such that $q(\alpha^*) = u + pv$.

To demonstrate that this efficient regulation can be defeated in a majority vote, we impose two additional conditions. The first condition guarantees that every young household can (and does) buy a house in the laissez-faire equilibrium:

Condition 2. $\quad k'(1 - H_O) \leq v.$

This simply states that the price of the house, when everyone buys a house, does not exceed the mortgage advance, when the mortgage interest rate is 0, as it is in the laissez-faire equilibrium under Assumption 3. The second condition guarantees that the coalition of old home-sellers and of young households excluded from homeownership under efficient regulation constitutes a majority of voters:

Condition 3. $\quad 1 - I^* \geq \frac{1+H_O}{2}.$

Note that the $1 - I^*$ is the sum of the measure of young households unable to buy a house under the efficient regulation, $(1 - (H_O + I^*))$, and the measure of old homeowners, H_O. With that, we now have sufficient conditions for what we call "political failure:"

Proposition 9. *If Assumptions 3 and 4 and Conditions 1, 2 and 3 are satisfied, then $\alpha = 0$ wins over $\alpha = \alpha^*$ in a simple majority vote.*

More generally, the efficient regulation $\alpha = \alpha^*$ loses to any lax regulation $\alpha \leq \tilde{\alpha}$, where $\tilde{\alpha}$ solves $k'(1 - H_O) = \frac{v}{1+\tilde{\alpha}r^*}$. Any such lax regulation gains support of the entire coalition of old homeowners and the "excluded" young, plus at least some votes from young home-buyers who can barely afford their house under the efficient regulation and who benefit from the de-facto mortgage subsidy arising under a lax regulation. Formally, these are young households with wealth in the interval $(\underline{w}(\alpha^*), \overline{w}(\alpha, \alpha^*))$.

Recall that any allocation with over-provision of housing ($I > I^*$) is not just inefficient from the utilitarian social planner's perspective — it is also Pareto inefficient. Thus, the outcome of the democratic process described in Proposition 9 is an allocation where everyone's utility can be improved upon. Of course, that does not mean that a Pareto improvement had been rejected by a majority of voters. The voters were permitted to choose only the level of a specific policy tool, namely the banking regulation. They were not permitted to bundle this regulation with an additional redistributive policy, which would have allowed for the Pareto improvement over the current allocation. Specifically, going from no regulation to $\alpha = \alpha^*$ (an improvement from the utilitarian social planner's standpoint) generates more losers than winners, and the winners lack the ability to compensate the losers without additional policy instruments being introduced.

The drastic nature of the sufficient conditions above, while illustrative of the possibility of the political failure, does obscure an interesting aspect of the voting behavior in a more general setting. Specifically, Condition 2 ensures that every young household buys a house under the lax regulation. The voting behavior among the young is then simply characterized by a single cutoff — those with wealth below $\overline{w}(0, \alpha*)$ vote for deregulation, while those with wealth above this threshold vote for efficient regulation. In the following subsection, we relax this assumption and point out that in the more general case, there is a group of wealth-poor young voters who join with the wealthiest young in their support of stricter banking regulation.

5.3 Ends Against the Middle

The nature of policy preferences among young households in our framework often features a key non-monotonicity in wealth. Whenever the poorest young cannot afford a house under either of the competing policies, they join with their wealthiest cohorts in supporting a stricter regulation, which yields higher expected rate of return on their deposits. At the same time, some middle-wealth young vote for the lax regulation. This "ends against the middle" property is similar to the political economy of public education in the presence of private option (Barzel (1973); Epple and Romano (1996a,b); Fernandez and Rogerson (1995)). But unlike the public education case, where middle-income voters were favoring socially efficient policies, in our setting, middle-income voters are the ones undermining the efficient regulation.

The "ends against the middle" feature is well illustrated by considering the preferred policy of young households as a function of their wealth, defined in equation (14). The properties of this policy bliss point as a function of wealth are illustrated in Figure 3 and the following proposition:

Proposition 10. *Suppose that Assumptions 3 and 4 hold. The preferred policy mapping has the following properties:*

- $A(w) = 1$ *for* $w < \underline{w}(0)$,
- $A(w) = 0$ *for* $w = \underline{w}(0)$,
- $A(w)$ *is increasing in* w *for* $w > \underline{w}(0)$.[18]

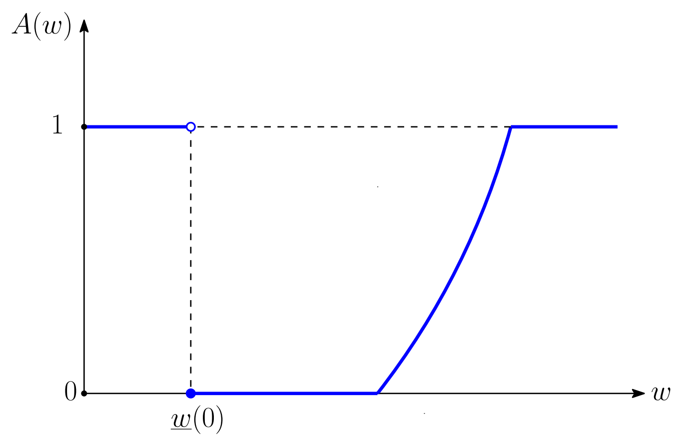

Figure 3: Preferred Policy

The non-monotonicity of the preferred policy as a function of wealth, established in Proposition 10, suggests that the simple intuition derived from standard median-voter theorem does not apply to the median wealth. Specifically, the median-wealth voter's preferred policy need not be the outcome of a majority voting equilibrium, even adjusting for the old home-sellers' share of the vote. Formalizing this statement

[18]That is, for any (w, w', α, α') such that $\underline{w}(0) \leq w < w'$, $\alpha \in A(w)$, and $\alpha' \in A(w')$, we have $\alpha \leq \alpha'$. This is stronger than the "strong set order" that is commonly used when comparing solution sets (e.g., Milgrom and Shannon (1994)).

requires a couple of definitions. When talking of the "outcome of a majority voting equilibrium," we refer to the standard notion of a Condorcet winner:[19]

Definition 2. *A policy α is a Condorcet winner if, for all $\alpha' \in [0,1]$,*

$$\int \mathbb{1}_{U(w;\alpha)\geq U(w;\alpha')} dF(w) + \mathbb{1}_{q(\alpha)\geq q(\alpha')} H_O \geq \frac{1+H_O}{2}.$$

In fact, even the concept of the median-wealth voter is less than straightforward in our environment. Besides the young voters with heterogeneous wealth levels, there are also the old homeowners who all vote as a single bloc. Given that these old voters tend to side with the relatively wealth-poor young against the wealth-rich young (as in Proposition 9), we define the "adjusted median" wealth $\widehat{w}$ as the one solving

$$F(\widehat{w}) + H_O = \frac{1+H_O}{2}.$$

This concept of adjusted median wealth is rather natural and somewhat informative. The following proposition illustrates a point familiar from the "ends-against-the-middle" papers: that the Condorcet winning policy is shifted away from the (adjusted) median-wealth voter's preferred policy toward that preferred by the "ends."

Proposition 11. *Suppose that Assumptions 3 and 4 hold and that $\widehat{w} > \underline{w}(0)$. If α is a Condorcet winner, then $\alpha \geq \min A(\widehat{w})$. Moreover, if $1 \in A(\widehat{w})$, then $\alpha = 1$ is a Condorcet winner.*

However, due to the potential non-monotonicity of the policy preferences, $A(\widehat{w})$ is not necessarily a natural candidate for a majority voting equilibrium outcome. A young household with the adjusted median wealth $\widehat{w}$ need not be a median voter in terms of policy preferences. A more relevant alternative, and the one we call "median voter," is a young voter with the median preferred policy. We denote the wealth of the median voter by w_m. Utilizing Proposition 10, we can define w_m as the solution of

$$H_O + F(w_m) - F(\underline{w}(0)) = \frac{1+H_O}{2}.$$

[19] Note that a Condorcet winner may not exist in our setting. One way to restore existence of equilibrium is by introducing orthogonal ideological preferences, as in Lindbeck and Weibull (1987), leading to the so-called probabilistic voting. In that augmented environment, the equilibrium outcome is a solution to a social planner's problem (as shown in Lindbeck and Weibull (1987)). If the idiosyncratic ideological preferences are identically distributed across all ages and wealth levels, then this social planner's problem is similar to the one described in Section 4.3 and the probabilistic voting equilibrium picks the efficient level of regulation α^*. However, if old and/or middle-wealth individuals are less ideologically polarized (have lower dispersion of the orthogonal idiosyncratic preferences), then these voters get greater weight in the pseudo-social planner's problem than the more polarized young voters at the extremes of wealth distribution, and the equilibrium outcome may thus feature an inefficiently low level of regulation.

This "median voter's wealth" is to the right of the "adjusted median wealth," i.e., $w_m \geq \widehat{w}$. Yet, the Condorcet winning policy still lands (weakly) to the right of the median preferred policy:

Proposition 12. *If Assumptions 3 and 4 hold, then*

- *If α is a Condorcet winner, then $\alpha \geq \min A(w_m)$.*
- *If $0 \in A(w_m)$, then $\alpha = 0$ is a Condorcet winner.*
- *If $1 \in A(w_m)$, then $\alpha = 1$ is a Condorcet winner.*

The reason for this "drift" of the winning policy to the right of the median preferred policy is the endogeneity of the threshold level of wealth that enables young households to buy a house, $\underline{w}(\alpha)$. If the median preferred policy features a positive level of regulation that excludes some people from buying a house, then these relatively wealth-poor households "switch sides" and join with the wealthiest in supporting yet more regulation. To see this, let $\alpha_m := \min A(w_m)$. Young households who lose ability to buy a house under regulation α_m (those with wealth $w \in [\underline{w}(0), \underline{w}(\alpha_m)))$ would vote for any α to the right of α_m in a bilateral choice against α_m, even though these households' preferred policies are to the left of α_m.

Contrasting Propositions 11 and 12 with Proposition 9 highlights the importance of the "ends-against-the-middle" mechanism for studying the effects of wealth inequality in this environment. On the one hand, analysis in Section 5.2 (where Condition 2 rules out the "ends-against-the-middle" mechanism) captures the key idea of Rajan (2010) and Calomiris and Haber (2014) — that increased wealth inequality increases the mass of (wealth poor) supporters of financial deregulation. On the other hand, if an increase in wealth inequality leads to more people not being able to afford a house, then such an increase in inequality would actually weaken the political support for deregulation.

6 Robustness

In this section, we discuss the sensitivity of our findings to some key simplifying assumptions we have made to keep the model tractable. The following subsections analyze implications of several key departures from our model setting, one at a time.

6.1 Dead-Weight Loss from Mortgage Crisis

We had assumed that neither mortgage default (foreclosure) nor bank failure was associated with any dead-weight loss. This simplifying assumption is obviously unrealistic, and we now consider several possible ways of relaxing it. Consider first the effects of a foreclosure externality. The negative spillovers of foreclosures on house price and other socioeconomic outcomes in the neighbourhood are well documented by Gerardi et al. (2015) and Mian, Sufi, and Trebbi (2015). In our model, we cannot introduce this externality as a reduction of the house price in the adverse aggregate state, since we assume that the house price in that state is already zero. Instead, we introduce this externality as a utility loss rather than a reduction in the house price. Specifically, we assume that this utility loss is increasing in the number of foreclosures and is imposed on all citizens. The uniformly applied utility loss does not affect the economic equilibria in our model for any given policy parameter, but it does, of course, affect the voting behavior. Since this externality is internalized by voters, it does reduce popular support for lax regulation on the margin, but our key results are robust to the introduction of a modest level of the externality.

Specifically, consider the aggregate dead-weight loss from a foreclosure crisis that takes the form of a utility loss proportional to the aggregate housing stock (all of which are foreclosed in the adverse aggregate state): $\frac{\phi}{1-p}(H_O + I)$, where $\phi > 0$ is the strength of the externality. This implies that the ex-ante expected utility loss from foreclosures is $\phi(H_0 + I)$.

This externality reduces the optimal level of housing investment. The modified planner's problem (11) becomes (the social planner's problem, Problem 4, can be adjusted similarly)

$$\max_I \left\{W - k(I) + (u + pv - \phi)(H_O + I)\right\}.$$

Let I^*_ϕ be the level of housing investment that equates the social marginal benefit and social marginal cost:

$$k'(I^*_\phi) = u + pv - \phi. \tag{16}$$

For I^*_ϕ to be well defined (and interior), the dead-weight loss must not be too large:

Assumption 5. $\phi \leq u + pv$.

Proposition 13. *Under Assumptions 1, 2, and 5, the socially optimal level of construction is I^*_ϕ, defined in (16).*

Since individuals are infinitesimal, they understand that each of their own economic decisions does not affect the aggregate housing stock or the dead-weight loss from a foreclosure crisis. Thus, the economic equilibrium analyzed thus far is unaffected. However, individuals internalize the dead-weight loss when voting for financial regulation. Their indirect utility function now includes the dead-weight loss:

$$U(w;\alpha) = \begin{cases} w\big(1 + \tilde{i}(\alpha)\big) - \phi\big(H_O + I(\alpha)\big), & \text{for } w < \underline{w}(\alpha), \\ u + \big(w - \underline{w}(\alpha)\big)\big(1 + \tilde{i}(\alpha)\big) - \phi\big(H_O + I(\alpha)\big), & \text{for } w \geq \underline{w}(\alpha). \end{cases} \tag{17}$$

We now show that our two main results —"political failure" (Proposition 9) and "ends against the middle" (Proposition 10) — still hold in the presence of modest foreclosure externality.[20] Specifically, we make the following assumption, which restricts the extent of the dead-weight loss:

Assumption 6. $F(u - \phi) > 1 - H_O - I^*_\phi$.

Note that this assumption implies both Assumption 4 and Assumption 5, since $\phi > 0$ and $I^*_\phi < I^*$. As the following proposition shows, this assumption implies that the maximum regulation is inefficiently tight.

Proposition 14. *If Assumptions 3 and 6 hold, then the equilibrium with maximum regulation ($\alpha = 1$) has an inefficiently low level of construction.*

The optimal regulation α^*_ϕ is then interior (the argument of Section 5.2 applies) and solves

$$q(\alpha^*_\phi) = u + pv - \phi.$$

We can now establish that our key political failure result still holds in the presence of the foreclosure externality, as long as it is not too large.

Proposition 15. *If Assumptions 3 and 6 and Conditions 1, 2, and 3 are satisfied, then $\alpha = 0$ wins over $\alpha = \alpha^*_\phi$ in a simple majority vote.*

While the introduction of the foreclosure externality does increase support for tougher regulation among home-buyers, it does not change the key result that young individuals would never prefer a policy that excludes them from buying a house. Similarly, the "ends-against-the-middle" also survives modest levels of the foreclosure externality:

Proposition 16. *Suppose that Assumptions 3 and 6 hold. The preferred policy mapping has the following properties:*

- $A(w) = 1$ *for* $w < \underline{w}(0)$,
- $A(w) = 0$ *for* $w = \underline{w}(0)$,
- $A(w)$ *is increasing in* w *for* $w > \underline{w}(0)$.

[20]The robustness of our results is, of course, not universal. If the externality from foreclosure is large enough, all voters may be willing to vote for the strictest of regulations.

That is, policy preferences of young voters are still successfully illustrated by Figure 3.

The key insights are also robust to associating the dead-weight loss with the bank failure (for empirical support for this, see, for example, Laeven and Valencia (2013, 2020)), as opposed to (or in addition to) the foreclosures. If this dead-weight loss is modelled simply as a utility cost applied to everyone alive at the time of the banking crisis, then the economic equilibria for any given policy parameter are unaffected, just as in the above case. And just like in that case, under modest levels of the externality, a group of middle-wealth young voters still join the initial old home-sellers in voting for lax banking regulation. An alternative way of modelling this externality as a proportional tax on remaining bank deposits (needed to cover the financial dead-weight loss of bank failure) further strengthens our key point. In such a setting, some political support for lax banking regulation amongst young voters would remain even when externality is arbitrarily large, as marginal home-buyers have very few deposits and thus bear very little of the cost of lax regulation while getting the bulk of the benefit.

6.2 Other Departures

This subsection contains discussion of implications of relaxing some other key simplifying assumptions of our model. Formal model extensions that would incorporate these departures are somewhat complicated and are beyond the scope of this paper, but we briefly discuss below the key forces and mechanisms associated with these departures from our assumptions.

6.2.1 Risk Aversion

For simplicity, we have assumed that all agents in the model are risk-neutral. A more natural assumption, of course, is that households are risk-averse. Incorporating risk aversion into the model would increase the social cost of lax regulation, as the *risk* of bank failure induces additional cost on depositors, beyond lowering the expected rate of return. But the basic political mechanism we highlight is still present. Marginal home-buyers still side with old homeowners in support of lax regulation. The benefit of being able to buy a house outweighs the cost of added risk on the deposits side, especially since these households have very small deposits when they buy a house.

6.2.2 Recourse Mortgages

We made a stark assumption that mortgages are defaultable and are non-recourse. This implies that mortgage lenders do not recover any part of the loan in the event of default, and that default is purely strategic. Of course, this drastic simplifying assumption is not supported empirically (see, for example, Gerardi et al. (2015) and Guiso, Sapienza, and Zingales (2013)). The implications of relaxing the non-recourse assumption are ambiguous but fairly intuitive. On the one hand, if intermediaries recover a portion of the defaulted loans, the aggregate losses in the adverse state are smaller, and the downside of lax regulation is correspondingly smaller as well. This may increase support for lax financial regulation. On the other hand, having to make (partial) repayment on a defaulted mortgages decreases the attractiveness of risky mortgages for middle-wealth home-buyers. The decline in support from this segment of the population makes lax regulation less likely to be the outcome of a political process.

6.2.3 Lobbying

Our analysis above focuses exclusively on popular support for financial regulation based on voters' economic outcomes. However, there is convincing empirical evidence for the presence and importance of lobbying, not least by financial institutions (e.g., Mian, Sufi, and Trebbi (2010, 2013)). Explicitly incorporating such lobbying into our model is somewhat tricky, as our lenders are competitive and thus earn zero expected profits regardless of the regulation. However, intuitive implications of adding lobbying are rather straightforward. If lenders benefit from the aggregate volume of loans, they always prefer (and lobby for) lax regulation. Another group of potential lobbyists in our environment are the owners of construction companies. In contrast to the financiers, construction firm owners do receive positive profits in equilibrium and are thus the most natural candidates for generating political contributions. Critically, their political preferences are simple and unambiguous — they always benefit from lax regulation, as it leads to greater house prices, greater levels of construction, and greater profits for construction firms.

To summarize, introducing lobbying into our environment would only strengthen political support for (inefficiently) lax financial regulation.

7 Conclusion

We have put forward a parsimonious model that captures one key intuitive message — there are two groups of households/voters who may have benefited from lax regulation of the mortgage lending industry. The first such group is relatively wealth-poor young households who cannot afford the down payment needed to buy a house under strict financial regulation. Under lax regulation though, banks are willing to advance risky mortgages to these households, charging less than actuarially fair interest rates. (These banks will themselves fail in the event of a negative aggregate house-value shock, and thus do not demand adequate compensation for the non-repayment risk in that aggregate state.) The added demand from the marginal young home-buyers, whose entry into the market is facilitated by the regulatory failure, pushes up the price of existing (as well as newly constructed) houses. This generates the second group of households who benefit from the lax regulation — incumbent (old) homeowners. This key economic insight translates into a simple political economy implication. If the coalition of old homeowners and young wealth-poor potential home-buyers is large enough, then regulatory failure (inefficiently lax financial regulation) can arise as an outcome of a democratic process. The regulatory failure in the model leads to inefficiently high levels of housing construction (fueled by a house-price bubble). In reality, this failure brings along additional costs of financial fragility, which is abstracted from in our model (as all agents are risk-neutral and there is no dead-weight loss associated with a banking crisis in the model).

The political economy of financial regulation in our environment does not depend on whether the construction boom generated by lax regulation is efficiency-improving or wasteful. The equilibrium in our model may have inefficiently low housing level when the aggregate wealth of young households is low. Under these parameter values, lax regulation improves aggregate efficiency. In contrast, when the aggregate wealth of young households is sufficiently high, the laissez-faire equilibrium has excessive levels of construction relative to the utilitarian social optimal. In that case, lax regulation lowers aggregate welfare. It is worth highlighting that only this latter case yields a housing bubble under lax regulation (i.e., the house price under lax regulation exceeds the fundamental value of the house). More importantly, regardless of the aggregate welfare implications, the distribution of welfare gains remains unchanged — marginal young home-buyers and old homeowners benefit from lax regulation, while renters and sub-marginal home-buyers lose.

The basic mechanism we are emphasizing applies not just to financial regulation, but to other potential government interventions. Take for example the "shared equity mortgage" program introduced by the Canada Mortgage and Housing Corporation (CMHC) in 2019. The idea of the government agency helping first-time home-buyers come up with a down payment on a house is touted as making housing more affordable. The basic point that such a policy would make homes more expensive rather than more affordable is not new. Our analysis highlights that nonetheless this policy of stimulating home-buying may well have political support from a coalition of wealth-poor prospective new home-buyers (who benefit from the policy directly) and existing homeowners (who reap the benefit of increased house prices).

Embedding our key mechanism in a dynamic setting yields two additional insights. First, current financial regulation affects not only the financial markets for the newly issued mortgages, but, by affecting the current house prices, it also affects the current default rate on old outstanding mortgages. This mechanism may provide an additional (political) motivation for lax financial regulation.[21] Second, the popular support for lax regulation is self-perpetuating, as lax regulation today leads to a larger voting group of old homeowners tomorrow. We leave explicit treatment of these issues for future work.

[21] Incorporating large lenders into such a dynamic environment could additionally capture the mechanism of Gupta (forthcoming), who highlights how decisions of (large) lenders to extend risky mortgages affect contemporaneous house prices.

References

Acharya, Viral V., Matthew Richardson, Stijn Van Nieuwerburgh, and Lawrence J. White. 2011. *Guaranteed to Fail: Fannie Mae, Freddie Mac, and the Debacle of Mortgage Finance*. Princeton University Press.

Adelino, Manuel, Antoinette Schoar, and Felipe Severino. 2016. "Loan Originations and Defaults in the Mortgage Crisis: The Role of the Middle Class." *Review of Financial Studies* 29 (7):1635–1670.

Albanesi, Stefania, Giacomo De Giorgi, and Jaromir Nosal. 2017. "Credit Growth and the Financial Crisis: A New Narrative." Tech. rep., National Bureau of Economic Research.

Barzel, Yoram. 1973. "Private Schools and Public School Finance." *Journal of Political Economy* 81 (1):174–186.

Bernanke, Ben S. 2010. "Monetary Policy and the Housing Bubble." Speech at the Annual Meeting of the American Economic Association, Atlanta, GA.

Bolton, Patrick and Howard Rosenthal. 2002. "Political Intervention in Debt Contracts." *Journal of Political Economy* 110 (5):1103–1134.

Brunnermeier, Markus K. 2009. "Deciphering the Liquidity and Credit Crunch 2007–2008." *Journal of Economic Perspectives* 23 (1):77–100.

Brusco, Sandro and Fabio Castiglionesi. 2007. "Liquidity Coinsurance, Moral Hazard, and Financial Contagion." *Journal of Finance* 62 (5):2275–2302.

Calomiris, Charles W. and Stephen H. Haber. 2014. *Fragile by Design: The Political Origins of Banking Crises and Scarce Credit*. Princeton University Press.

Chari, Varadarajan V. and Patrick J. Kehoe. 2008. "Time Inconsistency and Free-Riding in a Monetary Union." *Journal of Money, Credit and Banking* 40 (7):1329–1356.

Dell'Ariccia, Giovanni, Deniz Igan, and Luc Laeven. 2012. "Credit Booms and Lending Standards: Evidence from the Subprime Mortgage Market." *Journal of Money, Credit and Banking* 44 (2-3):367–384.

D'Erasmo, Pablo, Igor Livshits, and Koen Schoors. 2019. "Banking Regulation with Risk of Sovereign Default." Federal Reserve Bank of Philadelphia working paper.

Epple, Dennis and Richard E. Romano. 1996a. “Ends against the Middle: Determining Public Service Provision When There Are Private Alternatives.” *Journal of Public Economics* 62 (3):297–325.

———. 1996b. “Public Provision of Private Goods.” *Journal of Political Economy* 104 (1):57–84.

Favara, Giovanni and Jean Imbs. 2015. “Credit Supply and the Price of Housing.” *American Economic Review* 105 (3):958–992.

Fernandez, Raquel and Richard Rogerson. 1995. “On the Political Economy of Education Subsidies.” *Review of Economic Studies* 62 (2):249–262.

Foote, Christopher L., Lara Loewenstein, and Paul S. Willen. 2020. “Cross-Sectional Patterns of Mortgage Debt during the Housing Boom: Evidence and Implications.” *Review of Economic Studies* 88 (1):229–259.

Gerardi, Kristopher, Eric Rosenblatt, Paul S. Willen, and Vincent Yao. 2015. “Foreclosure Externalities: New Evidence.” *Journal of Urban Economics* 87:42–56.

Guiso, Luigi, Paola Sapienza, and Luigi Zingales. 2013. “The Determinants of Attitudes toward Strategic Default on Mortgages.” *Journal of Finance* 68 (4):1473–1515.

Gupta, Deeksha. forthcoming. “Too Much Skin-in-the-Game? The Effect of Mortgage Market Concentration on Credit and House Prices.” *Review of Financial Studies* .

Igan, Deniz, Prachi Mishra, and Thierry Tressel. 2012. “A Fistful of Dollars: Lobbying and the Financial Crisis.” *NBER Macroeconomics Annual* 26 (1):195–230.

Jeske, Karsten, Dirk Krueger, and Kurt Mitman. 2013. “Housing, Mortgage Bailout Guarantees and the Macro Economy.” *Journal of Monetary Economics* 60 (8):917–935.

Kiyotaki, Nobuhiro, Alexander Michaelides, and Kalin Nikolov. 2011. “Winners and Losers in Housing Markets.” *Journal of Money, Credit and Banking* 43 (2-3):255–296.

Laeven, Luc and Fabian Valencia. 2013. “Systemic Banking Crises Database.” *IMF Economic Review* 61 (2):225–270.

———. 2020. “Systemic Banking Crises Database II.” *IMF Economic Review* 68 (2):307–361.

Lindbeck, Assar and Jörgen W. Weibull. 1987. “Balanced-Budget Redistribution as the Outcome of Political Competition.” *Public Choice* 52 (3):273–297.

Mian, Atif and Amir Sufi. 2009. "The Consequences of Mortgage Credit Expansion: Evidence from the US Mortgage Default Crisis." *Quarterly Journal of Economics* 124 (4):1449–1496.

Mian, Atif, Amir Sufi, and Francesco Trebbi. 2010. "The Political Economy of the US Mortgage Default Crisis." *American Economic Review* 100 (5):1967–1998.

———. 2013. "The Political Economy of the Subprime Mortgage Credit Expansion." *Quarterly Journal of Political Science* 8 (4):373–408.

———. 2015. "Foreclosures, House Prices, and the Real Economy." *Journal of Finance* 70 (6):2587–2634.

Milgrom, Paul and Chris Shannon. 1994. "Monotone Comparative Statics." *Econometrica* 62 (1):157–180.

Ortalo-Magné, François and Andrea Prat. 2014. "On the Political Economy of Urban Growth: Homeownership versus Affordability." *American Economic Journal: Microeconomics* 6 (1):154–181.

Parkhomenko, Andrii. 2018. "The Rise of Housing Supply Regulation in the US: Local Causes and Aggregate Implications." Mimeo.

Rajan, Raghuram G. 2010. *Fault Lines: How Hidden Fractures Still Threaten the World Economy*. Princeton University Press.

Sheedy, Kevin. 2018. "Taking Away the Punch Bowl: Monetary Policy and Financial Instability." Mimeo.

Tressel, Thierry and Thierry Verdier. 2014. "Optimal Prudential Regulation of Banks and the Political Economy of Supervision." *IMF Working Papers* 2014 (90).

Zingales, Luigi. 2008. "Causes and Effects of the Lehman Brothers Bankruptcy." In *Committee on Oversight and Government Reform US House of Representatives*. 34–59.

A Characterization of Economic Equilibrium

A.1 Solution to the Young Households' Problem

In this subsection, we characterize the solution to Problem 2. We begin by solving the mortgage choice problem for those who buy a house. We then turn to the home-purchase decision.

A.1.1 Mortgage Choice of Homeowners

A household with wealth w who buys a house ($h = 1$) solves the following mortgage/deposit choice problem:

$$\begin{aligned}
&\max_{d,m}\Big[(1-p)\Big((1+i)(1-\tau)d\Big) + p\Big((1+i)d + v - (1+r)m\Big)\Big] \\
&\text{subject to } d + q = w + m, \\
&\qquad (1+r)m \le v, \\
&\qquad m \ge \max\{q-w, 0\},
\end{aligned}$$

where the last condition states that deposits and mortgages cannot be negative.

Denoting the expected rate of return on deposits by $\tilde{i} := [1-(1-p)\tau](1+i)-1$, the objective function can be rewritten as $[(1+\tilde{i})d + p(v-(1+r)m)]$. Plugging in the budget constraint yields simply

$$\begin{aligned}
&\max_{m}\Big[(1+\tilde{i})(w-q) + pv + \Big((1+\tilde{i}) - p(1+r)\Big)m\Big] \\
&\text{subject to } (1+r)m \le v, \\
&\qquad m \ge \max\{q-w, 0\},
\end{aligned}$$

Note that the objective function is linear in m, and thus, the solution is characterized as follows:

$$m(w)\begin{cases} = \max\{q-w,0\} & \text{for } 1+\tilde{i} < p(1+r), \\ \in \left[\max\{q-w,0\}, \frac{v}{1+r}\right] & \text{for } 1+\tilde{i} = p(1+r), \\ = \frac{v}{1+r} & \text{for } 1+\tilde{i} > p(1+r). \end{cases}$$

Since $\tau \le 1$, $1+\tilde{i} = [1-(1-p)\tau](1+i) \ge p(1+i)$. Furthermore, in the laissez-faire environment (where $i = r$), $1+\tilde{i} \ge p(1+r)$. More generally, Lemma 11 ensures that we can consider solely the case $m(w) = \frac{v}{1+r}$ without loss of generality.

A.1.2 Homeownership Choice

Buying a house is feasible only for those with sufficient wealth (i.e., $w \geq q - \frac{v}{1+r}$).

With the maximum size of mortgage, the utility of buying a house is

$$u + (1+\tilde{i})(w-q) + pv + \Big((1+\tilde{i}) - p(1+r)\Big)\frac{v}{1+r} = u + (1+\tilde{i})\left(w - q + \frac{v}{1+r}\right).$$

In contrast, the utility of not buying a house is $(1+\tilde{i})w$. Therefore, the utility gain from homeownership is positive if and only if $q \leq \overline{q}$, where

$$\overline{q} := \frac{u}{1+\tilde{i}} + \frac{v}{1+r}. \tag{18}$$

As long as $q < \overline{q}$ (Proposition 5), everyone who can afford to buy a house will buy one.

A.2 Expected Losses on Deposits

This subsection derives the expression for the fraction of deposits at risk in an economic equilibrium under arbitrary level of regulation α.

Since all banks make zero expected profit in equilibrium, the aggregate expected profits are also zero:

$$(1-p)\Big(S - (1+i)(1-\tau)D\Big) + p\Big(S + (1+r)M - (1+i)D\Big) - E = 0. \tag{19}$$

Aggregating banks' balance sheets gives $M + S = D + E$. Substituting this into (19) gives the fraction of deposits held by mortgage banks:

$$\tau = \frac{i + \Big(1 - p(1+r)\Big)\frac{M}{D}}{(1-p)(1+i)} = \left[\frac{1-p(1+r)}{1-p}\right]\frac{M}{D} = (1-\alpha)\frac{M}{D},$$

where we used $i = 0$ (Lemma 10) and $r = \alpha r^*$ (Lemma 6).

Because $M = \frac{Hv}{1+r}$ (Lemma 11) and $M - D = qH - W$,

$$\frac{M}{D} = \frac{\frac{v}{1+r}H}{\frac{v}{1+r}H - (qH - W)} = \left[1 + \left(\frac{1+r}{v}\right)\left(\frac{W}{H} - q\right)\right]^{-1}.$$

Thus, τ becomes

$$\tau = (1-\alpha)\left[1 + \left(\frac{1+r}{v}\right)\left(\frac{W}{H} - q\right)\right]^{-1}. \tag{20}$$

A.3 Equilibrium Equations

When $i = 0$ (Lemma 10) and $q < \overline{q}$ (Proposition 5), the equilibrium values (r, q, I, τ) solve

$$\begin{aligned}
r =& \alpha r^*, \\
q =& k'(I), \\
H_O + I =& 1 - F\left(q - \frac{v}{1+r}\right), \\
\tau =& (1-\alpha)\left[1 + \left(\frac{1+r}{v}\right)\left(\frac{W}{H_O + I} - q\right)\right]^{-1}.
\end{aligned}$$

Since we can simply plug the first two equations into the last two equations, this reduces to a system of two equations and two unknowns.

B Proofs

We begin with two preliminary results that are helpful for other proofs in this section.

Lemma 12. *In any equilibrium, $i \geq 0$.*

Proof. Consider a strategy $m = e = 0$ (i.e., $s = d$), which yields the expected profit $s - (1+i)d = -id$. When $i < 0$, the expected profit is strictly increasing in d. This means that there is no solution to the bank's problem. $\square$

Lemma 13. *In any equilibrium, $r \leq r^*$.*

Proof. Consider a strategy $s = d = 0$ (i.e., $m = e$), which yields the expected profit $p(1+r)m - e = \big(p(1+r) - 1\big)e$. When $r > r^*$, the expected profit is strictly increasing in e. This means that there is no solution to the bank's problem. $\square$

B.1 Proof of Lemma 1

Suppose that there is an equilibrium where some banks (or investors) purchase both mortgages and the safe asset, that is, $m > 0$ and $s > 0$. To establish that there is an outcome-equivalent equilibrium with specialization, we simply split such "diversified" investors into two specialized components and show that this specialized allocation also solves the banker's problem.

First, consider the case where the bank defaults on (some) deposits in the event of the adverse housing shock (i.e., where limited liability on deposits is binding). In this case, the (maximized) expected profit is

$$p\Big((1+r)m + s - (1+i)d\Big) - e = 0,$$

where $m > 0$ and $0 < s < (1+i)d$. The fact that the bank cannot further increase the expected profit implies that $i = 0$, as otherwise the bank could increase the expected profit by increasing or decreasing both s and d by the same amount (which would not violate the regulatory constraint (1)). In turn, $i = 0$ means that we can divide the bank into two banks with zero expected profits: (i) a mortgage bank with $m' = m$, $s' = 0$, $d' = d - s > 0$, and $e' = e$, and (ii) a safe bank with $d'' = s'' = s$ and $m'' = e'' = 0$. The two specialized banks' strategies are profit-maximizing and meet the regulatory constraint (1).

Next, consider the case of an investor or a bank that does not default on deposits regardless of the realization of the housing shock. The (maximized) expected profit in that case is

$$p(1+r)m + s - (1+i)d - e = 0,$$

where $m > 0$, $s > 0$, and $s \geq (1+i)d$. If $r < r^*$, then the bank could increase the expected profit by reducing m and e by the same amount. Moreover, $r \leq r^*$ by Lemma 13. Therefore, $r = r^*$ must hold. In turn, $r = r^*$ implies that we can break the bank into two entities with zero expected profits: (i) a mortgage investor with $m' = e' = m$ and $s' = d' = 0$, and (ii) a safe bank with $s'' = s$, $d'' = d$, $m'' = 0$, and $e'' = e - m \geq 0$, where $e \geq m$ is implied by $i \geq 0$ (Lemma 12) and $s \geq (1+i)d$. The two specialized banks' strategies are profit-maximizing and meet the regulatory constraint (1).

B.2 Proof of Lemma 2

The first-order necessary condition for profit maximization of the construction firm (Problem 3) is

$$q = k'(I).$$

Suppose that $I = 0$ in equilibrium. Then $q = 0$ also holds because $k'(0) = 0$. When $q = 0$, all young individuals can buy a house without a mortgage and enjoy the benefit from the house $u + pv > 0$. Therefore, the demand for house is 1, while the supply is H_O. Since $H_O < 1$, $q = 0$ does not clear the housing market. Thus, $I > 0$ in equilibrium.

B.3 Proof of Lemma 3

From the budget constraint (2) and the borrowing limit (4), the maximum amount of resources young households can raise in the first period is $w + \frac{v}{1+r}$. Therefore, young households can buy a house if and only if $w \geq q - \frac{v}{1+r}$.

B.4 Proof of Lemma 4

Suppose that there is an equilibrium where some banks hold more than the minimal amount of equity required by the regulation. That is, $e > \alpha m$. To establish that there is an outcome-equivalent equilibrium with all banks holding the minimal amount of equity required by the regulation, we simply split such banks into a bank that holds the minimal amount of equity and a private-equity investor, and show that this alternative allocation is also consistent with profit maximization.

First, consider the case of a mortgage bank. The maximized expected profit is

$$p\Big((1+r)m - (1+i)d\Big) - e = 0,$$

where $e > \alpha m > 0$ and $d > 0$. If $r < r^*$, then the bank could increase the expected profit by reducing m and e by the same amount. Moreover, $r \leq r^*$ by Lemma 13. Therefore, $r = r^*$ must hold. In turn, $r = r^*$ implies that we can break the bank into two entities with zero expected profits: (i) a mortgage bank with $e' = \alpha m' = \frac{\alpha}{1-\alpha} d$ and $d' = d$, and (ii) a private-equity investor with $m'' = e'' = m - \frac{d}{1-\alpha} > 0$ and $d'' = 0$, where $m > \frac{d}{1-\alpha}$ is implied by $e > \alpha m$ and $m = d + e$. These two strategies are profit-maximizing, meet the regulatory constraint (1), and combine to the same overall allocation as the original bank.

Next, consider the case of a safe bank. The (maximized) expected profit in that case is

$$s - (1+i)d - e = 0,$$

where $s > 0$, $d > 0$, and $e > 0$. We can break this bank into two entities with zero expected profits: (i) a safe bank with $s' = s - e$, $e' = 0$, and $d' = d$, and (ii) a private-equity investor with $s'' = e'' = e$ and $d'' = 0$. These two strategies are profit-maximizing, meet the regulatory constraint (1), and combine to the same overall allocation as the original bank.

B.5 Proof of Lemma 5

1. By Lemma 4, it suffices to consider a mortgage bank with $e = \alpha m$. Then the identify $m = d + e$ implies $d = (1-\alpha)m$. The expected profit from a given strategy m, $e = \alpha m$, and $d = (1-\alpha)m$ is

$$p\Big((1+r)m - (1+i)d\Big) - e = \Big(p\Big((1+r) - (1+i)(1-\alpha)\Big) - \alpha\Big)m.$$

When $p\Big((1+r)-(1+i)(1-\alpha)\Big)-\alpha > 0$, there is no solution to the bank's problem because the bank can increase the expected profit by increasing m. Therefore, $p\Big((1+r) - (1+i)(1-\alpha)\Big) - \alpha \leq 0$ must hold.

When there are some mortgage banks in equilibrium, the expected profit must be non-negative for some $m > 0$. This is possible only when $p\Big((1+r) - (1+i)(1-\alpha)\Big) - \alpha = 0$.

2. $i \geq 0$ follows from Lemma 12. By Lemma 4, it suffices to consider a safe bank with $e = 0$ (i.e., $s = d$). Its expected profit is $s - (1+i)d = -id$. When there are some safe banks in equilibrium, the expected profit must be non-negative for some $d > 0$. This is possible only when $i = 0$.

3. $r \leq r^*$ follows from Lemma 13. Consider a private-equity investor that specializes in mortgage (i.e., $m = e$ and $d = s = 0$). Its expected profit is $p(1+r)m - e = \Big(p(1+r) - 1\Big)e$. When there are some private-equity investment in mortgages in equilibrium, the expected profit must be non-negative for some $m > 0$. This is possible only when $r = r^*$.

B.6 Proof of Lemma 6

Suppose that $\alpha < 1$ and there are no mortgage banks in equilibrium. Then there must be safe banks because the aggregate supply of deposit is strictly positive (because the wealth distribution is non-degenerate). The existence of safe banks implies $i = 0$ (Lemma 5). In turn, $i = 0$ implies $r \leq \alpha r^*$ (due to $p\Big((1+r) - (1+i)(1-\alpha)\Big) - \alpha \leq 0$ from Lemma 5). Because $\alpha < 1$, $r < r^*$ holds and there cannot be any private-equity investment in mortgages. That is, the aggregate supply of mortgages is zero.

On the one hand, because there are no mortgage banks, no banks fail. That is, $\tau = 0$ and the expected return on deposit is $1 + i = 1$. On the other hand, $r < r^*$ implies that the expected return on mortgages, $p(1+r)$, is smaller than 1. Therefore, everyone who buys a house takes out the maximum size of mortgage $m = \frac{v}{1+r}$ (see Section A.1.1), and the aggregate demand for mortgages is strictly positive. Because the mortgage market does not clear, there cannot be an equilibrium without mortgage banks.

Therefore, there must be some mortgage banks and $\tau > 0$ in equilibrium when $\alpha < 1$, and $r = \alpha r^* + (1-\alpha)i$ must hold (Lemma 5). Combining this with $i \geq 0$ (Lemma 12) and $r \leq r^*$ (Lemma 13) gives $i \in [0, r^*]$.

B.7 Proof of Lemma 7

When $\alpha = 1$, there are no mortgage banks and $\tau = 0$. Therefore, as shown in the proof of Lemma 6, there must be both safe banks and private-equity investment in mortgages to meet strictly positive aggregate demand for deposits and mortgages. This implies $r = r^*$ and $i = 0$ must hold (Lemma 5) when $\alpha = 1$.

B.8 Proof of Lemma 8

When $\alpha = 0$, $e = \alpha m = 0$ for mortgage banks (Lemma 4) and $i = r$ holds (Lemma 6). Since there are always mortgage banks (Lemma 6), the fraction of deposit held by mortgage banks, $\tau = D_M/(D_M + D_S)$, is strictly positive.

B.9 Proof of Proposition 1

When $\alpha = 0$, mortgage banks hold zero equity (Lemma 4) and $i = r \in [0, r^*]$ holds (Lemmata 6 and 8). While there are always mortgage banks, there cannot be both safe banks and private-equity investment in mortgages (Lemma 5). Therefore, it suffices to consider the following three cases:

1. There are only mortgage banks and safe banks: In this case, $M = D_M$ and $D = D_M + D_S$ hold. Therefore, $M - D = -D_S < 0$ and $\tau = D_M/D \in (0, 1)$. The fact that there are safe banks implies $i = r = 0$ (Lemma 5).

2. There are only mortgage banks: In this case, $M = D = D_M$. Therefore, $M - D = 0$ and $\tau = D_M/D = 1$.

3. There are only mortgage banks and private-equity investment in mortgages: In this case, $M = D_M + M_P$ and $D = D_M$. Therefore, $M - D = M_P > 0$ and $\tau = D_M/D = 1$. The fact that there are private-equity investment in mortgages implies $i = r = r^*$.

B.10 Proof of Proposition 2

The three equality constraints of Problem 4 imply

$$C_O + pC_L + (1 - p)C_H = W - k(I) + pv(H_O + I).$$

Therefore, Problem 4 is identical to the modified problem (11) with additional inequality constraints. Because $I = I^*$ solves the modified problem, it also solves Problem 4 if all inequality constraints can be satisfied at $I = I^*$.

Consider an allocation with $I = I^*$, $A_L = 0$, $A_H = -v(H_O + I^*)$, $C_O = W - k(I^*) + pv(H_O + I^*)$ $C_L = C_H = 0$. Because of Assumptions 1 and 2, such allocation satisfies all inequality constraints. Therefore, $I = I^*$ solves Problem 4.

B.11 Proof of Proposition 3

Let $\hat{c}_O$ and $(\hat{c}_L(w), \hat{c}_H(w), \hat{h}(w))$ be an allocation of consumption for the old and consumption and housing for the young with wealth level w such that $\hat{I} := \int \hat{h}(w)dF(w) - H_O > I^*$. We will show that there is an alternative feasible allocation under which no one is worse off and someone is strictly better off.

Let $\mathcal{W} \subset \mathbb{R}_+$ be a set of wealth levels such that $\hat{h}(w) = 1$ for all $w \in \mathcal{W}$ and $\int_{\mathcal{W}} dF(w) = \varepsilon > 0$. Consider an alternative allocation $\tilde{c}_O = \hat{c}_O$, $(\tilde{c}_L(w), \tilde{c}_H(w), \tilde{h}(w)) = (\hat{c}_L(w), \hat{c}_H(w), \hat{h}(w))$ for all $w \notin \mathcal{W}$ and, for all $w \in \mathcal{W}$,

$$\begin{aligned}
\tilde{c}_L(w) =& \hat{c}_L(w) + \frac{k(\hat{I}) - k(\tilde{I})}{\varepsilon} - pv, \\
\tilde{c}_H(w) =& \hat{c}_H(w) + \frac{k(\hat{I}) - k(\tilde{I})}{\varepsilon} - pv, \\
\tilde{h}(w) =& 0,
\end{aligned}$$

where $\tilde{I} := \int \tilde{h}(w)dF(w) - H_O = \hat{I} - \varepsilon$.

This allocation is resource-feasible, that is,

$$\begin{aligned}
&\tilde{c}_O + \int \Big((1-p)\tilde{c}_L(w) + p\tilde{c}_H(w)\Big)dF(w) \\
=&\left[\hat{c}_O + \int \Big(p(1-p)\hat{c}_L(w) + p\hat{c}_H(w)\Big)dF(w)\right] + \left[\int_{\mathcal{W}} \left(\frac{k(\hat{I}) - k(\tilde{I})}{\varepsilon} - pv\right) dF(w)\right] \\
=&\Big[W - k(\hat{I}) + pv(H_O + \hat{I})\Big] + \Big[k(\hat{I}) - k(\tilde{I}) - pv\varepsilon\Big] \\
=&W - k(\tilde{I}) + pv(H_O + \tilde{I}).
\end{aligned}$$

The old and the young with $w \notin \mathcal{W}$ are indifferent between the alternative allocation and the original allocation. In contrast, the young with $w \in \mathcal{W}$ experience the utility gain

$$\Big[u\tilde{h}(w) + (1-p)\tilde{c}_L(w) + p\tilde{c}_H(w)\Big] - \Big[u\hat{h}(w) + (1-p)\hat{c}_L(w) + p\hat{c}_H(w)\Big] = -u + \frac{k(\hat{I}) - k(\hat{I} - \varepsilon)}{\varepsilon} - pv,$$

which is strictly positive if and only if

$$\frac{k(\hat{I}) - k(\hat{I} - \varepsilon)}{\varepsilon} > u + pv. \tag{21}$$

Since $\hat{I} > I^*$ implies $k'(\hat{I}) = \lim_{\varepsilon \to 0} \frac{k(\hat{I}) - k(\hat{I} - \varepsilon)}{\varepsilon} > u + pv$, there exists $\varepsilon > 0$ such that (21) holds. Notice that (21) also implies that the consumption of the young is positive in each state. Therefore, the original allocation with $\hat{I} > I^*$ is not Pareto optimal.

B.12 Proof of Lemma 9

This is a special case of Lemma 10.

B.13 Proof of Proposition 4

Suppose that $I \leq I^*$ holds in any equilibrium with $\alpha = 0$. We first show that $q < \overline{q}$ holds. Since $i = r = 0$ (Lemma 9), we have

$$\overline{q} = \frac{u}{1 - (1 - p)\tau} + v > u + pv = k'(I^*) \geq k'(I) = q,$$

where the first inequality holds because $\tau \geq 0$ and $p < 1$ and the second inequality follows from $I \leq I^*$.

Next, $q < \overline{q}$ implies that the aggregate demand for housing is $1 - F(q - v)$. Thus, the housing market clearing condition gives

$$1 - H_O = I + F\big(k'(I) - v\big) \leq I^* + F\big(k'(I^*) - v\big) = I^* + F\big(u - (1 - p)v\big),$$

where the inequality follows from $I \leq I^*$. This contradicts Condition 1. Therefore, $I > I^*$ must hold when Condition 1 is satisfied.

B.14 Proof of Proposition 5

We first show that $\overline{q} \geq u + pv$. Since $i = 0$ (Lemma 10), we have

$$\overline{q} = \frac{u}{1 - (1 - p)\tau} + \frac{v}{1 + r}.$$

Because $r \leq r^*$ (Lemma 13) and $\tau \geq 0$, $\overline{q} \geq u + pv$ holds.

Next, suppose that $q = \overline{q}$. Then the housing market clearing condition gives

$$H_O + I \leq 1 - F\left(\overline{q} - \frac{v}{1+r}\right) = 1 - F\left(\frac{u}{1-(1-p)\tau}\right).$$

Because $\tau \geq 0$ and $q \geq u + pv$ (which implies $I \geq I^*$), the above inequality further implies

$$H_O + I^* \leq 1 - F(u),$$

which contradicts Assumption 4. Therefore, $q < \overline{q}$ must hold.

B.15 Proof of Lemma 10

Aggregating young households' budget constraint (2) gives

$$M - D = qH - W.$$

In any equilibrium, $q \leq \overline{q}$ holds, where $\overline{q}$ is given by (from (18))

$$\overline{q} = \frac{u}{[1-(1-p)\tau](1+i)} + \frac{v}{1+r}.$$

From Lemma 6, $i \geq 0$ and $r \geq 0$ hold. Moreover, $\tau \leq 1$ holds by definition. Therefore,

$$\overline{q} \leq \frac{u}{p} + v.$$

This implies

$$M - D \leq \overline{q}H - W \leq \frac{u}{p} + v - W.$$

Thus, $M < D$ holds by Assumption 3.

That means that mortgage banks cannot absorb all of the deposits in the economy ($D_M \leq M$), and thus some deposits must end up in safe banks.

B.16 Proof of Lemma 11

Since $i = 0$ (Lemma 10), the expected return on deposit is $1 - (1-p)\tau$. The expected (gross) rate paid on mortgages is $p(1+r)$. We first establish that $1 - (1-p)\tau > p(1+r)$ whenever $\alpha < 1$. With $i = 0$ and

$M + S = D + E$, the aggregate zero expected profit condition (19) of the financial sector becomes

$$1 - \Big(1 - (1-p)\tau\Big) = \Big(1 - p(1+r)\Big)\frac{M}{D}.$$

Because $M < D$ (Lemma 10), this implies $1 - (1-p)\tau > p(1+r)$. Since the expected rate of return on deposits is greater than the expected rate paid on mortgages, all home-buyers always take out the largest mortgage when $\alpha < 1$ (see Section A.1.1). Therefore, maximum mortgage is the only possible equilibrium outcome when $\alpha < 1$.

When $\alpha = 1$, the expected rates of return on deposits and mortgages are the same: $1-(1-p)\tau = p(1+r)$ holds because $r = r^*$ (Lemma 6) and $\tau = 0$ (Lemma 7). Therefore, home-buyers are indifferent regarding the size of the mortgage they take out, as long it is sufficient for them to afford the house purchase. Importantly though, the mortgage choice does not affect the home purchase decision. Therefore, any equilibrium in which home-buyers take out mortgages of various sizes is identical in terms of (q, H, i, r, τ) to the equilibrium in which all home-buyers take out the largest possible mortgage. Of course, the aggregate quantities of mortgages (M) and deposits (D) are shifted by the same amount as we "switch" to the maximum-mortgage equilibrium, but that does not affect consumption or utility of households. Regulatory constraint is also unaffected since all mortgages come from private-equity investors when $\alpha = 1$.

B.17 Proof of Proposition 6

Since $r = \alpha r^*$ (Lemma 10), and $q < \overline{q}$ (Proposition 5), the equilibrium housing investment I satisfies

$$H_O + I = 1 - F\left(k'(I) - \frac{v}{1+\alpha r^*}\right). \tag{22}$$

For any given α, the left-hand side of this equation is increasing in I, while the right-hand side is decreasing in I.

Since an increase in α reduces the right-hand side of (22), equilibrium levels of I (and $q = k'(I)$) must be decreasing in α in order for (22) to hold. In turn, the observation that I is decreasing in α implies that $\underline{w} = k'(I) - \frac{v}{1+\alpha r^*}$ must be increasing in α.

From (20), the fraction of deposits held by mortgage banks is

$$\tau = (1-\alpha)\left[1 + \left(\frac{1+\alpha r^*}{v}\right)\left(\frac{W}{H} - q\right)\right]^{-1}.$$

Since H and q are decreasing in α, τ is decreasing in α.

It is easy to see that τ is strictly decreasing and $\underline{w}$ is strictly increasing in α, while q, H, and I are constant when the homeownership rate is 100% (i.e., $F(\underline{w}) = 0$).

B.18 Proof of Proposition 7

When $\alpha = 1$, $\tau = i = 0$ and $r = r^*$ (Lemmas 6 and 7), which implies $\overline{q} = u + pv$. Because $q < \overline{q}$ (Proposition 5), $I < I^*$ holds and the equilibrium investment is inefficiently low when $\alpha = 1$.

B.19 Proof of Proposition 8

The results follow from Proposition 6.

Households who cannot afford a house under the more lax regulation α certainly cannot afford it under the stricter regulation α'. That is, $w < \underline{w}(\alpha)$ implies $w < \underline{w}(\alpha')$, which follows from $\underline{w}(\alpha)$ being strictly increasing in α. Therefore, these households are concerned only with the expected return on their deposits and thus prefer the stricter regulation: $U(w;\alpha') - U(w;\alpha) = w\left(\tilde{i}(\alpha') - \tilde{i}(\alpha)\right) > 0$, because τ is strictly increasing in α.

For those with $w \in \left[\underline{w}(\alpha), \underline{w}(\alpha')\right)$, the stricter regulation α' precludes them from buying a house, thus making them worse off than under the looser regulation α:

$$\begin{aligned} U(w;\alpha') - U(w;\alpha) =& w\left(1 + \tilde{i}(\alpha')\right) - \left[u + \left(w - \underline{w}(\alpha)\right)\left(1 + \tilde{i}(\alpha)\right)\right] \\ <& \underline{w}(\alpha') - u \\ \leq& q(1) - pv - u \\ <& 0, \end{aligned}$$

where the first inequality follows from $w \in \left[\underline{w}(\alpha), \underline{w}(\alpha')\right)$ and $\tilde{i}(\alpha') \leq 0$, the second inequality holds due to $\underline{w}(\alpha') \leq \underline{w}(1) = q(1) - pv$, and the third inequality reflects $q(1) < u + pv$ (Proposition 7).

Finally, for those with $w \geq \underline{w}(\alpha')$,

$$\begin{aligned} U(w;\alpha') - U(w;\alpha) =& \left(w - \underline{w}(\alpha')\right)\left(1 + \tilde{i}(\alpha')\right) - \left(w - \underline{w}(\alpha)\right)\left(1 + \tilde{i}(\alpha)\right) \\ =& w\left(\tilde{i}(\alpha') - \tilde{i}(\alpha)\right) - \underline{w}(\alpha')\left(1 + \tilde{i}(\alpha')\right) + \underline{w}(\alpha)\left(1 + \tilde{i}(\alpha)\right). \end{aligned}$$

Because $\tilde{i}(\alpha') > \tilde{i}(\alpha)$, we have

$$U(w;\alpha') - U(w;\alpha) \begin{cases} < 0, & \text{for } w < \overline{w}(\alpha,\alpha'), \\ = 0, & \text{for } w = \overline{w}(\alpha,\alpha'), \\ > 0, & \text{for } w > \overline{w}(\alpha,\alpha'), \end{cases}$$

where $\overline{w}(\alpha,\alpha')$ is given by (15). Moreover, $\overline{w}(\alpha,\alpha') > \underline{w}(\alpha')$ holds because $\underline{w}(\alpha) < \underline{w}(\alpha')$.

B.20 Proof of Corollary 1

This immediately follows from $U(w;\alpha') < U(w;\alpha)$ for $w \in \left[\underline{w}(\alpha), \underline{w}(\alpha')\right)$ (Proposition 8).

B.21 Proof of Proposition 9

We first show that Condition 2 implies $F\left(\underline{w}(0)\right) = 0$. Suppose that $F\left(\underline{w}(0)\right) > 0$. Because $q(0) < \overline{q}(0)$ (Proposition 5), the housing market clearing condition under $\alpha = 0$ implies

$$H_O + I(0) = 1 - F\left(\underline{w}(0)\right) < 1.$$

Because $k'(\cdot)$ is an increasing function, this can be written as

$$k'\left(I(0)\right) < k'(1 - H_O) \leq v,$$

where the last inequality holds due to Condition 2. Therefore, $\underline{w}(0) = k'(I(0)) - v < 0$ and, thus $F\left(\underline{w}(0)\right) = 0$. This contradicts $F\left(\underline{w}(0)\right) > 0$, and therefore $F\left(\underline{w}(0)\right) = 0$ must hold.

By Propositions 6 and 8, young households with wealth levels $w \in \left[\underline{w}(0), \overline{w}(0,\alpha^*)\right]$ and the old home-sellers prefer $\alpha = 0$ to $\alpha = \alpha^*$. Therefore, the number of people who would vote for $\alpha = 0$ over $\alpha = \alpha^*$ is

$$H_O + F\left(\overline{w}(0,\alpha^*)\right) - F\left(\underline{w}(0)\right) > H_O + F\left(\underline{w}(\alpha^*)\right) = 1 - I^*,$$

where the inequality holds because $\overline{w}(0,\alpha^*) > \underline{w}(\alpha^*)$ (see Proposition 8) and $F(\underline{w}(0)) = 0$ (Condition 2); and the equality reflects the housing market clearing condition under $\alpha = \alpha^*$. When Condition 3 holds, $1 - I^*$ exceeds 50% of population, $(H_O + 1)/2$. Therefore, $\alpha = 0$ wins over $\alpha = \alpha^*$ in a majority voting.

B.22 Proof of Proposition 10

The first two properties follow from Proposition 8. Suppose that the third property does not hold. That is, there exist (w, w', α, α') such that $\underline{w}(0) \le w < w'$, $\alpha \in A(w)$, $\alpha' \in A(w')$, and $\alpha > \alpha'$. Since $\alpha \in A(w)$, $\underline{w}(\alpha) \le w$ must hold (Corollary 1). This also implies $\underline{w}(\alpha') < \underline{w}(\alpha) \le w < w'$ because $w < w'$, $\alpha > \alpha'$, and $\underline{w}(\cdot)$ is strictly increasing (Proposition 6). Therefore,

$$\begin{aligned} U(w';\alpha) - U(w';\alpha') =& w'\big(\tilde{i}(\alpha) - \tilde{i}(\alpha')\big) - \underline{w}(\alpha)\big(1 + \tilde{i}(\alpha)\big) + \underline{w}(\alpha')\big(1 + \tilde{i}(\alpha')\big) \\ >& w\big(\tilde{i}(\alpha) - \tilde{i}(\alpha')\big) - \underline{w}(\alpha)\big(1 + \tilde{i}(\alpha)\big) + \underline{w}(\alpha')\big(1 + \tilde{i}(\alpha')\big) \\ =& U(w;\alpha) - U(w;\alpha') \\ \ge& 0, \end{aligned}$$

where the first inequality follows from $w < w'$, $\alpha > \alpha'$, and $\tilde{i}(\cdot)$ being strictly increasing (Proposition 6), and the second inequality reflects $\alpha \in A(w)$. However, this contradicts $\alpha' \in A(w')$. Thus, the third property must hold.

B.23 Proof of Proposition 11

Let $\widehat{\alpha} := \min A(\widehat{w})$. Suppose that α is a Condorcet winner and $\alpha < \widehat{\alpha}$. Since median-wealth ($\widehat{w}$) household strictly prefers $\widehat{\alpha}$ to α (by construction), and since $\widehat{w} \ge \underline{w}(\widehat{\alpha}) \ge \underline{w}(\alpha)$ (by Corollary 1), it follows from Proposition 8 that $\widehat{w} > \overline{w}(\alpha, \widehat{\alpha})$. Proposition 8 further implies that $U(w;\alpha) < U(w;\widehat{\alpha})$ holds for all $w > \overline{w}(\alpha, \widehat{\alpha})$. But that means that the mass of people who strictly prefer $\widehat{\alpha}$ to α constitutes a majority of votes:

$$1 - F\big(\overline{w}(\alpha, \widehat{\alpha})\big) > 1 - F(\widehat{w}) = \frac{1 + H_O}{2}.$$

This contradicts α being a Condorcet winner. Therefore, any Condorcet winner α cannot be smaller than $\widehat{\alpha}$.

Next, when $1 \in A(\widehat{w})$, $U(w;\alpha) \le U(w;1)$ holds for all $w \ge \widehat{w}$ (Proposition 8). Therefore, $\alpha = 1$ has at least a majority support against all $\alpha' < 1$ and thus is a Condorcet winner.

B.24 Proof of Proposition 12

Let $\alpha_m := \min A(w_m)$. Suppose that α is a Condorcet winner and $\alpha < \alpha_m$. By Proposition 8, $U(w;\alpha) < U(w;\alpha_m)$ holds for all $w > \overline{w}(\alpha,\alpha_m)$ and $w < \underline{w}(\alpha)$. Because $\overline{w}(\alpha,\alpha_m) < w_m$ holds due to $\alpha < \alpha_m$,

$$1 - F\big(\overline{w}(\alpha,\alpha_m)\big) + F\big(\underline{w}(\alpha)\big) > 1 - F(w_m) + F\big(\underline{w}(0)\big) = \frac{1+H_O}{2}.$$

Therefore, we have more than a majority support for α_m over α, which contradicts that α is a Condorcet winner. Therefore, any Condorcet winner α cannot be smaller than α_m.

Next, when $1 \in A(w_m)$, $U(w;\alpha) \leq U(w;1)$ holds for all $w \geq w_m$ and $w < \underline{w}(0)$ (Proposition 8). Therefore, $\alpha = 1$ has at least a majority support against all $\alpha' < 1$ and thus is a Condorcet winner.

Finally, when $0 \in A(w_m)$, $U(w;\alpha) \leq U(w;0)$ holds for all $w \in [\underline{w}(0), w_m]$ (Proposition 8). Therefore, $\alpha = 0$ has at least a majority support against all $\alpha' > 0$ and thus is a Condorcet winner.

B.25 Proof of Proposition 13

This follows from the proof of Proposition 2, $I^*_\phi < I^*$, and the properties of $k(\cdot)$.

B.26 Proof of Proposition 14

When $\alpha = 1$ and the housing price is given by $u + pv - \phi$, the aggregate housing demand is $1 - F(u-\phi)$ and the aggregate housing supply is $H_O + I^*_\phi$. By Assumption 6, the housing supply exceeds the housing demand at the price $u + pv - \phi$. Therefore, $q(1)$ must be lower than $u + pv - \phi$ to clear the housing market.

B.27 Proof of Proposition 15

The proof is identical to that of Proposition 9, except that we now use Lemma 14 instead of Proposition 8:

Lemma 14. *Consider two levels of banking regulation α and α', where $\alpha' > \alpha$. Then, under Assumptions 3 and 6,*

$$U(w;\alpha') - U(w;\alpha) \begin{cases} > 0, & \text{for } w < \underline{w}(\alpha), \\ < 0, & \text{for } w \in \big[\underline{w}(\alpha), \underline{w}(\alpha')\big), \\ < 0, & \text{for } w \geq \underline{w}(\alpha') \text{ and } w < \overline{w}(\alpha,\alpha'), \\ = 0, & \text{for } w \geq \underline{w}(\alpha') \text{ and } w = \overline{w}(\alpha,\alpha'), \\ > 0, & \text{for } w \geq \underline{w}(\alpha') \text{ and } w > \overline{w}(\alpha,\alpha'), \end{cases}$$

where

$$\overline{w}(\alpha,\alpha') = \frac{\underline{w}(\alpha')(1+\tilde{i}(\alpha')) - \underline{w}(\alpha)(1+\tilde{i}(\alpha)) + \phi\big(I(\alpha') - I(\alpha)\big)}{\tilde{i}(\alpha') - \tilde{i}(\alpha)} \tag{23}$$

is the wealth level of the young house-buyer indifferent between the two policy.

Proof. The proof is very similar to that of Proposition 8, but we reproduce the full step here for completeness.

Households who cannot afford a house under the more lax regulation α certainly cannot afford it under the stricter regulation α'. That is, $w < \underline{w}(\alpha)$ implies $w < \underline{w}(\alpha')$, which follows from $\underline{w}(\alpha)$ being strictly increasing in α. Therefore, these households are concerned only with the expected return on their deposits and the dead-weight loss, and thus they prefer the stricter regulation: $U(w;\alpha') - U(w;\alpha) = w\big(\tilde{i}(\alpha') - \tilde{i}(\alpha)\big) - \phi\big(I(\alpha') - I(\alpha)\big) > 0$, because τ is strictly increasing in α and I is strictly decreasing in α.

For those with $w \in \big[\underline{w}(\alpha), \underline{w}(\alpha')\big)$, the stricter regulation α' precludes them from buying a house, thus making them worse off than under the looser regulation α:

$$\begin{aligned} U(w;\alpha') - U(w;\alpha) =& w\big(1+\tilde{i}(\alpha')\big) - \Big[u + \big(w - \underline{w}(\alpha)\big)\big(1+\tilde{i}(\alpha)\big)\Big] - \phi\big(I(\alpha') - I(\alpha)\big) \\ <& \underline{w}(\alpha') - u - \phi\big(I(\alpha') - I(\alpha)\big) \\ \le& q(1) - pv - u - \phi\big(I(\alpha') - I(\alpha)\big) \\ <& -\phi\big(1 + I(\alpha') - I(\alpha)\big) \\ <& 0, \end{aligned}$$

where the first inequality follows from $w \in \big[\underline{w}(\alpha), \underline{w}(\alpha')\big)$ and $\tilde{i}(\alpha') \le 0$, the second inequality holds due to $\underline{w}(\alpha') \le \underline{w}(1) = q(1) - pv$, the third inequality reflects $q(1) < u + pv - \phi$ (Proposition 14), and the final inequality holds because $I(\alpha) \in [0, 1 - H_O]$ for all α.

Finally, for those with $w \ge \underline{w}(\alpha')$,

$$\begin{aligned} U(w;\alpha') - U(w;\alpha) =& \big(w - \underline{w}(\alpha')\big)\big(1+\tilde{i}(\alpha')\big) - \big(w - \underline{w}(\alpha)\big)\big(1+\tilde{i}(\alpha)\big) - \phi\big(I(\alpha') - I(\alpha)\big) \\ =& w\big(\tilde{i}(\alpha') - \tilde{i}(\alpha)\big) - \underline{w}(\alpha')\big(1+\tilde{i}(\alpha')\big) + \underline{w}(\alpha)\big(1+\tilde{i}(\alpha)\big) - \phi\big(I(\alpha') - I(\alpha)\big). \end{aligned}$$

Because $\tilde{i}(\alpha') > \tilde{i}(\alpha)$, we have

$$U(w;\alpha') - U(w;\alpha) \begin{cases} < 0, & \text{for } w < \overline{w}(\alpha,\alpha'), \\ = 0, & \text{for } w = \overline{w}(\alpha,\alpha'), \\ > 0, & \text{for } w > \overline{w}(\alpha,\alpha'), \end{cases}$$

where $\overline{w}(\alpha, \alpha')$ is given by (23). However, $\overline{w}(\alpha, \alpha') > \underline{w}(\alpha')$ may not hold. □

B.28 Proof of Proposition 16

The proofs of the first two properties are identical to those of Proposition 10, except that we now use Lemma 14 instead of Proposition 8. It is easy to see that the proof for the third property also works with the dead-weight loss because the dead-weight loss does not interact with the level of individual wealth (i.e., $U(w; \alpha) - U(w; \alpha')$ does not depend on w).